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THE UNIVERSITY OF ALBERTA

ONCOLOGY NURSES' PERCEPTIONS OF OCCUPATIONAL EXPOSURE TO ANTINEOPLASTIC DRUGS

BY

PEGGY JANE SZUMLAS

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF NURSING

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Date: May 17, 1989

Dedication

This thesis is dedicated to my family. To my husband John for his support, infinite patience, understanding, objectivity and creative thought in critically analyzing my many drafts. To my cousins, Jan and Laura for providing the opportunity through Cancer for my initiation and practicum into attitudinal healing, creative visualization, and the power of positive thought, including the "Course in Miracles" which helped this dream become a reality; enabling me to truly "travel the journey without distance." To my parents who inspired and encouraged me to persist in this educational pursuit. Thank you for your unfailing support.

Abstract

This study was intended to facilitate the understanding of factors involved in nurses' perceptions regarding the use of personal protective devices in the preparation and administration of antineoplastic drugs. This was an exploratory study, descriptive in nature, to investigate oncology nurses' perceptions regarding antineoplastic drug preparation and administration and their relationship to the use of personal protective equipment, specifically eyeglasses, masks, gowns, and gloves. The Health Belief Model was adapted and used in the construction of a 94 item questionnaire. Personal interviews were conducted with 124 Registered Nurses who were currently employed in an active treatment oncology setting with a history of working with antineoplastic drugs.

Aspects of the Health Belief Model utilized in this investigation included the following elements: perceived susceptibility, perceived severity, general health, and perceived barriers. Structural, socio-environmental, and demographic variables were also investigated.

Years of oncology and general nursing experience, age, perceived susceptibility, and self-reported health status accounted for 50.5% of the variability in personal protective equipment usage. In general, nurses who regarded themselves as being susceptible to adverse health conditions as a result of preparing or administering antineoplastic drugs were more likely to follow safe work practices. Years of oncology and nursing experience, level of health, and age were negatively correlated with equipment use. The nurses' age and increasing level of reported health correlated with less frequently reported usage of personal protective equipment. Other variables failed to demonstrate a significant relationship with equipment utilization, including: perceived severity, previous skin contact with antineoplastic drugs, knowledge of safe handling and administration practices, and co-worker influence. As in previous studies, there was an increase over time reported in glove use during antineoplastic drug preparation.

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In addition to my family, I would like to express my appreciation to my many friends and colleagues whose support and guidance aided in the successful completion of this thesis. I would like to thank Dr. Dana Wertenberger, my thesis committee chair-person for her valuable leadership in piloting our mutual exploration of the Health Belief Model constructs in the "unchartered territory" of oncology nurses' perceptions of exposure to antineoplastic drugs. I would also like to thank Dean Wood and Professor Jean Innes for their valuable contributions and thought-provoking questions and suggestions which provided me with greater insight. I am especially indebted to Dr. Tee Guidotti for his expertise in Occupational Health, which continually challenged me to reach my potential in Occupational Health Nursing. The committee's painstaking editorial input was gratefully appreciated in making each draft dramatically better than the previous one. I would also like to acknowledge Dr. Janice Lander for her initial contributions in launching this study. I am grateful to Dr. Shirley Stinson for the opportunity and her encouragement to pursue my interest in furthering my study of Occupational Health Nursing within the Faculty of Nursing.

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Introduction

There is mounting evidence that there are health risks associated with chronic or recurrent occupational exposure to antineoplastic drugs. Although environmental controls reduce the risk of exposure to antineoplastic drugs, accidental contacts with the drugs still do occur. There is evidence that protective clothing and equipment can reduce or even eliminate potential health risks from accidental exposure to antineoplastic drugs. However, the use of protective practices has been found to be poor or non-existent in the past despite policies that have been developed in many institutions to minimize the direct contact with antineoplastics during preparation and administration of the drugs (Valanis & Shortridge, 1987). The factors that influence self-protective behaviors in nurses who prepare and administer antineoplastic drugs have remained a matter of speculation.

This study investigated oncology nurses' perceptions regarding antineoplastic drug preparation and administration and their relationship to the use of personal protective equipment. A positive, exploratory, and descriptive methodology was employed to survey oncology nurses' perceptions regarding their occupational exposure to antineoplastic drugs. The positive aspect of this study was opposed to a negative model of determining the nurses reasons for not wearing personal protective equipment.

Why people engage in health promoting behaviors raises issues of their perceptions about health, their perceived susceptibility to illness and the perceived severity of contracting an illness. The Health Belief Model attempts to explain why, in the absence of symptoms, people participate in behaviors to protect their health. Because of its apparent applicability to the problem, the Health Belief Model was adapted as a conceptual framework for this investigation, to the extent that an individual's perceptions precede a health related action and bear upon the course of that action (Rosenstock, 1974).

The Health Belief Model components support the claim that in the absence of symptoms a person will not take action to avoid an illness unless there is a readiness to act. The "readiness to act" is characterized by the perceptions of susceptibility or vulnerability,

severity, the belief that the action is feasible, efficacious and that the benefits of the action would outweigh the barriers or costs of that action. The combination of the perceptions interacting with modifying factors, activates a "cue for action" which triggers a person to comply with or engage in a given health behavior (Chen & Land, 1986; Katatsky, 1977; Mikhail, 1981; Pender, 1982, 1987; Ramsay, 1985; Rosenstock, 1974).

The terms "susceptibility" and "vulnerability" are used synonymously in the literature, but the two are not used interchangeably in this study. Susceptibility may be a precursor to vulnerability, however the state of being "vulnerable" is not a topic suitable for investigation in this inquiry. Susceptibility refers to a state in which a "disease has not developed but the groundwork has been laid by the presence of factors (risk factors) that favor its occurrence ... even when there is a strong statistical association between a risk factor and a disease, this does not mean that all individuals with the risk factor will necessarily develop the disease nor that the absence of the risk factor will ensure absence of the disease" (Mausner & Bahn, 1985, p.6). For example, fair-skinned, blonde hair people are susceptible to sunburn; age, sex, race, cigarette smoking, blood pressure, blood cholesterol levels, physical activity level, and 'stress' are considered coronary risk factors, increasing a person's susceptibility of having a heart attack (Wright & Bailey, 1981). For the purposes of this study therefore, the term "susceptibility" is used to refer to the nurses' subjective perception of their risk of having their health affected by antineoplastic drugs.

Vulnerability refers to a state in which the affected person has sustained some injury or other weakened condition as distinct from a normal condition, even though they may be asymptomatic and there are no manifestations of disease. For example, a roofer occupationally exposed to tar is vulnerable to sunburn as a result of petroleum bi-products sensitizing the pigment of the skin (Molyneux, 1981); a person with influenza may be vulnerable to pneumonia.

Although there have been few direct applications of the Health Belief Model in the occupational health field, and none in relation to oncology nurses and their personal protective practices in antineoplastic drug preparation and administration, data from other studies can be adapted to the model's dimensions. Oncology nurses' drug handling practices and the frequency in which personal protective equipment was reported in two American studies can be compared with findings in this study. Those studies, Crudi, Stephens and Maier (1982), and Valanis and Shortridge (1987) surveyed oncology nurses in detail regarding the use of safe work practices.

Crudi et al. surveyed 547 nurse members of the Oncology Nursing Society. Mailed questionnaires inquired about the precautionary measures, as well as the adverse reactions that nurses handling antineoplastic drugs experienced.

In a subsequent study, Valanis and Shortridge compared the nurses' utilization of protective measures in a variety of work settings and identified the circumstances in which and the reasons why protective measures were not used by nurses handling antineoplastic drugs. The sample consisted of 632 nurses holding membership in the Oncology Nursing Society, who at the time had mixed or administered antineoplastic drugs.

Comparison of the results of the two studies revealed that the consistent use of gloves during drug preparation had increased from 29% in 1981 to 76% in 1985. The use of gowns, masks or goggles was significantly less however, ranging from 3-48% during preparation, with even less frequent use during administration of the drug to patients (Crudi et al.; Valanis & Shortridge). Workers not using available equipment or garments to protect themselves from hazards in their occupational environments is not new or unique to antineoplastic drug preparation and administration, or to the health care setting. The provision of protective clothing and equipment does not guarantee compliance (Valanis & Shortridge).

Antineoplastic drugs are widely used; about 30 are available commercially and another 70 are at various stages of clinical development (Anderson et al., 1982). Although no Canadian study statistics were found, it is estimated that in the United States, these agents are given to 200,000 to 400,000 patients annually (Devita, 1982). Engelking and Steele (1984) estimate that the treatment regime of over 85% of patients with cancer often includes receiving chemotherapy, resulting in an increasing number of nurses being occupationally exposed to antineoplastic drugs during preparation and administration. The Oncology Nursing Society in 1983 estimated that 20,000 American registered nurses could be employed in oncology nursing, however the number of nurses who would have prepared or administered antineoplastic drugs was not determined (Rogers, 1984; Rogers & Emmett, 1987). One would conclude that there would be a corresponding number of nurses occupationally exposed to the drugs during preparation and administration. This number would likely increase if all the other countries' nurses and health care professionals who prepared and administered antineoplastic drugs were considered.

Antineoplastic drugs fall into four main categories: alkylating agents; mitotic inhibitors; antimetabolites and antibiotics (Sorsa, Hemminki, & Vainio, 1985). Antineoplastic agents, many of which are potent chemicals, have an irritant effect on skin, eyes and mucous membranes. Allergic and local reactions, dermatitis, and corneal ulcerations resulting from eye splashes, have been reported (Gross, Johnson, & Bertino, 1981; Knowles & Virden, 1980). Anecdotal reports of nausea, vomiting, dizziness and headaches vary with the intensity and duration of exposure to antineoplastic drugs (Crudi, 1980; Hunt, 1984). Exposure to antineoplastic agents occurs primarily through inhalation of the aerosolized drug product, ingestion, and direct skin contact (Reich, 1981; Zimmerman, Larsen, Barkley, & Gallelli, 1981).

The International Agency for Research on Cancer [IARC] has listed some antineoplastic drug compounds for which there is sufficient evidence of human

carcinogenicity and mutagenicity (Vainio, Hemminki, & Wilbourn,1985). The first documented indication that health care professionals who prepare and/or administer these drugs might be at risk, was published in a study from Finland (Falk et al., 1979). Ensuing studies based on nonspecific biological markers of internal dose, such as urine mutagenicity, have yielded contradictory results (Anderson et al., 1982; Benhamou et al., 1986; Bos, Leenaars, Theuws, & Henderson, 1982; Cloak et al., 1985 ; Connor, Theiss, Anderson, Puckett, & Matney, 1986; Hoffman, 1983; Kolmodin-Hedman, Hartvig, Sorsa, & Falck, 1983; Nguyen, Theiss, & Matney,1982; Pohlova, Cerna, & Rossner, 1986; Rogers, 1984; Sorsa, Pyy, Salomaa, Nylund, & Yager, 1988; Staiano, Gallelli, Adamson, & Thorgeirsson, 1981; Stucker, Hirsch, Doloy, Bastie-Sigeac, & Hemon, 1986; Venitt, Crofton-Sleigh, Hunt, Speechley, & Briggs, 1984).

Biological monitoring reports of cytogenetic effects have also been refutatory (Jordan, Patil, Jochimsen, Lachenbruch, & Corder, 1986; Nikula, Kiviniitty, Leisti, & Taskinen, 1984; Norppa et al., 1980; Pohlova et al., 1986; Sorsa, Pyy, Salomaa, Nylund, Yager, 1988; Stiller, Obe, Boll, & Pribilla, 1983; Stucker et al., 1986; Waksvik, Klepp, & Brogger, 1981). Consequently, the effects on health care professionals from long-term, low-level exposure to antineoplastic drugs is unclear (Miller, 1987; Vainio et al., 1985).

Cytotoxic agents handled by health care professionals confounds the study of health effects because these drugs are usually administered in combinations, not one-at-a-time, and may even be administered in conjunction with radiation and hormonal therapies (Hunt, 1984; Sorsa et al., 1985). Precautions to minimize direct contact with antineoplastic drugs seems to eliminate observable urine concentrate mutagenicity and complaints of side effects, but there is a lack of longitudinal studies that investigate the long-term health effects (Crudi et al., 1982; Hunt, 1984).

Reich (1981) concludes that the lack of longitudinal, epidemiologic studies on nurses and pharmacists, is compounded by the fact that so few health care professionals are

chronically exposed to antineoplastic agents. "If all the personnel at risk from multiple centers were included in a study, there probably would not be sufficient numbers to perform a prospective study. Cancer, which is estimated to occur at a rate of 1 per 1,000 per year in the general population, approximately 18,000 exposed and 18,000 nonexposed individuals would have to be observed to detect a twofold increase in the risk" (Reich). Given the latency of developing adverse health effects, if a worker did contract cancer, it would be impossible to determine if it was solely by chance, or if the cancer was related to occupational antineoplastic drug exposure. Consequently, further research is needed to develop more specific and efficient biological monitoring regimes than the ones that are currently in use.

Antineoplastic drugs are designed to cause cell dysfunction by interacting with D.N.A., R.N.A., or protein synthesis in living cells, normal or cancerous (Vaughn & Christensen, 1985). Recent studies regarding the adverse effects of antineoplastic agent exposure on reproduction in health care personnel is inconclusive. Studies regarding the potential abortive and teratogenetic effects of chemotherapeutic agents have cautioned health care workers about such possibilities during the first trimester of pregnancy. This is due to the fact that embryos and fetuses have a large number of growing cells and are especially susceptible to the toxic effects of cytotoxic agents, which disrupt cell growth and kill actively growing cells (Zimmerman et al., 1981). A Finnish investigation reported that nurses who had experienced a fetal loss, were 2.3 times as likely to have had a first trimester exposure to antineoplastic drugs, as nurses who had not been exposed (Selevan, Lindbohm, Hornung & Hemminki, 1985). The study suggests that such an association is cause for concern. Further studies are needed not only to investigate spontaneous abortions, but to investigate other potential adverse effects on reproduction such as infertility.

People make decisions regarding their health on their existing beliefs (Katatsky, 1977). Such scientists as Hochbaum; Kegeles; Leventhal and Rosenstock focused their research attention during the early 1950's on people's failure to comply with preventive health measures. An outcome of their inquiries was the development of a theory to explain the public's failure to accept illness preventives, and health behaviors (Rosenstock, 1974; Trepton-Adams, 1980). This preventive health behavior theory evolved into "The Health Belief Model", and asserts that the appearance and direction of preventive health behavior is determined by the individual's subjective beliefs toward a given condition, rather than on objective facts (Rosenstock). Following several revisions and modifications, the current Health Belief Model represents an integration of several theories, and is useful as a framework for examining preventive-health, as well as illness and sick-role behaviors (Becker & Maiman, 1975; Janz & Becker, 1984). The Health Belief Model is the most prominent socio-behavioral framework used to explain asymptomatic health behavior with health beliefs (Chen & Land, 1986). As a result the model is a very appropriate conceptual framework to guide the researcher's exploration of the nurses' perceptions about working with antineoplastic drugs and the use of protective measures.

While the model offers direction, the way in which its components can be operationalized allows for flexibility in structuring questions about beliefs and other predisposing factors that may have an effect on behavior (Mullen, Hersey & Iverson, 1987). The flexibility and generalizability of the model can lead to measurement errors. To minimize the errors in examining abstract concepts such as beliefs and attitudes that cannot be directly measured, it is recommended that multiple indicators be used to measure the various aspects of the variable (Chen & Land, 1986).

The Health Belief Model hypothesizes that in the absence of symptoms an individual will not take action to avoid a disease unless the following conditions are satisfied. First, the individual must be psychologically ready to take action relative to a particular health

condition. The extent of "readiness" is determined by whether the individual feels susceptible to the particular condition in question, and perceives the consequences of contracting the condition as serious. Secondly, the individual must believe that the preventive measure is feasible and efficacious; that the benefits of taking action outweigh the possible barriers. For example the individual's perceptions of susceptibility and seriousness of contracting the adverse health condition would be reduced, without enduring substantial barriers such as inconvenience, pain or embarrassment. Thirdly, a stimulus (internal or external to the individual) or "cue to action" must occur to trigger the appropriate behavior (Chen & Land, 1986; Katatsky, 1977; Mikhail, 1981; Pender, 1982, 1987; Ramsay, 1985; Rosenstock, 1974).

A group of modifying and enabling factors are thought to indirectly promote or discourage health behaviors. Examples of these factors include demographic variables; barriers to action; socio-environmental factors such as social and peer pressure; family relationships; health behavior intentions; and past health experiences. The modifying-enabling factors interact in some unknown way with the perceived readiness to take action, and determine whether or not a health behavior will occur. It is theorized that the combination of perceptions interacting with the factors, activates a cue for action, triggering a person to engage in given health behaviors, although it is not clear which combinations lead to higher levels of health behaviors than other factor-perception combinations (Feuerstein, Labbe, & Kuczmierczyk, 1986; Ramsay, 1985).

Even though the Health Belief Model consists of multiple components, the specific variables used in this study included perceived susceptibility, perceived severity, general health, perceived barriers, structural variables, socio-environmental factors, and demographic variables. The model's "readiness component" was adapted in the survey instrument to contain questions concerning the oncology nurses perceptions of susceptibility to having their health affected by antineoplastic drug handling, the perceived

severity of contracting an illness as a result of occupational exposures to antineoplastic drugs, and the nurses' general concern for their own health. The "modifying and enabling component" of the survey instrument was made up of perceived barriers that nurses reported in wearing personal protective equipment to reduce occupational exposure to antineoplastic drugs, structural variables including knowledge concerning antineoplastic drugs, socio-environmental factors such as co-worker influence in health practices, and demographic variables that may affect the nurse's perception and thus indirectly influence health-related behavior. Perceived susceptibility, perceived severity and perceived barriers were particularly included in the formulation of the survey questionnaire, because Janz and Becker (1984) cited that perceived susceptibility has been a strong contributor to understanding preventive health behaviors as opposed to sick role behaviors. In contrast, perceived severity is more strongly related to sick role behaviors and only weakly associated with preventive health behaviors. The perceived barrier factor is noted to be the most powerful variable of the Health Belief Model across various study designs that attempt to explain health behaviors (Janz & Becker, 1984).

Some studies of health behavior report positive correlations between high levels of susceptibility and compliance with various health-related behaviors (Champion, 1987; Desharnais, Godin, & Jobin, 1987; Janz & Becker, 1984). In lifestyle practices such as smoking, where the health risks are widely known, the personalization of consequences may be vital in influencing behavior (Mullen et al., 1987). Study results on perceived severity and acceptance of preventive health recommendations are more inconsistent than those for susceptibility (Feuerstein et al., 1986; Janz & Becker). There is some evidence that individuals who perceive that becoming ill will have serious effects, will comply with recommended health behaviors (Dai & Catanzaro, 1987; Feuerstein et al.). However, if the level of perceived severity is too high, fear will incapacitate the person and hinder compliance. An individual with a low level of perceived severity (not suffering any health

symptoms), will not be motivated to act (Chaffee & Roser, 1986; Feuerstein et al). The contention that the lack of motivation is directly related to the absence of physiological symptoms may be applicable to the perceived onset of occupational diseases. Given the latency of developing health problems from long-term low-level occupational exposures, the worker may not be motivated to take preventive action. It would appear that the presence of symptoms would be preferable, as a more realistic appraisal of disease severity may be elicited, thereby promoting the acceptance of recommended health behaviors. This is supported by studies finding no significant relationship between perceived severity and participation in several types of screening and immunization programs (Leventhal, Zimmerman, & Gutmann, 1984). However, perceived barriers were found to be the most powerful dimension across various study designs, and were significantly correlated with high levels of preventive health practices evidenced by increased self-reports of breast self-examination (Champion, 1985, 1987). The association between compliance and demographic variables such as education, age, income or ethnicity, has been very low to non-existent in studies among the general population (Champion, 1985; Peck, 1978).

A positive association between social support (married or having frequent contact with relatives, close friends, neighbors; active in social, professional or recreational groups) and health promoting behaviors was identified, especially in people who are older than 50 years of age (Hibbard, 1988). At younger ages social support may be equally influential in health behaviors as in older ages, however the effect is likely to be mixed. For instance in younger populations, peer pressure may have either a positive or a negative effect in promoting health behaviors. Mermelstein, Cohen, and Lichtenstein (1986) reported that social support was linked to health promoting behaviors such as the initiation and maintenance of smoking cessation. Gottlieb and Green (1984) and Pratt (1976) cited that extra-familial participation and involvement in social networks were positively correlated to women's health-related behaviors. In general, having more social ties and having a greater

health interest appear to contribute to lesser health-damaging and more health promoting behaviors (Hibbard).

This study was conducted to describe selected variables cited in the oncology nurse and antineoplastic drug literature in a more consistent, organized fashion utilizing the Health Belief Model as its conceptual framework. The adaptation of the model to the study's design and survey instrument focuses on the assessment of health beliefs and behavioral outcomes. Specifically, oncology nurses were investigated for the possible relationships between their perceived susceptibility of having their health affected by the preparation and administration of antineoplastic drugs, their perceived severity of contracting potential health effects associated with antineoplastic drug exposures, combined with modifying and enabling variables, and their use of personal protective equipment during antineoplastic drug preparation and administration.

Assumptions

At the onset of this study, it was assumed that the study population represented a group of oncology nurses characteristic of an active treatment institution that prepares as well as administers antineoplastic drugs to its patients. A "learning hierarchy" was also assumed in this sample of oncology nurses in which acquired knowledge leads to attitude change and from that behavior change (Chaffee & Roser, 1986). This study was conducted on the assumption that education and training regarding the safe preparation and administration of antineoplastic drugs is a prerequisite for the actual practice of preparing and administering the drugs.

Self-reports were used in this study to obtain information from the respondents that would be difficult, if not impossible, to gather by any other means. Based upon the reports by Sackett and Haynes, it is assumed that self-reports are grounded in self-perception, and self-report measurements tend to under-report noncompliance with recommended health practices, and to over-report compliance (1976). In an attempt to

increase the accuracy of self-reported practices, conditions such as providing a confidential, relaxed, and trusting interview atmosphere were established. As well, anonymity in reporting the study's findings was guaranteed in that the characteristics of the entire study group were described, thus preventing the identification of any individual (Hilbert, 1985).

Research Questions

The following questions guide the investigation into the potential relationships between the oncology nurses' perceptions regarding antineoplastic drug preparation and administration, and the utilization of personal protective equipment in the survey instrument:

I. Are the oncology nurses' perceptions regarding their susceptibility to adverse health effects from preparing or administering antineoplastic drugs related to the nurse's utilization of personal protective equipment during antineoplastic drug preparation or administration?

II. Is the utilization of personal protective equipment related to the nurse's feelings concerning the seriousness of contracting an illness arising from preparing or administering antineoplastic drugs?

III. Is an oncology nurse's self-reported level of health related to the utilization of personal protective equipment during antineoplastic drug preparation or administration?

IV. Are demographic variables such as the oncology nurse's age related to personal protective equipment utilization during antineoplastic drug preparation or administration?

V. Do oncology nurses who report a high level of knowledge regarding the safe preparation and administration of antineoplastic drugs, also report a high utilization of personal protective equipment during antineoplastic drug preparation or administration?

VI. Does accidental skin contact with antineoplastic drugs influence the nurses subsequent use of personal protective equipment during antineoplastic drug preparation or administration?

VII. Do nurses who report being influenced a great deal by co-workers, in their decision to wear personal protective equipment during antineoplastic drug preparation or administration, differ from those nurses who report being influenced to a lesser extent?

Definition of Terms

In this survey, antineoplastic drugs were classified into the following pharmacological categories:

Alkylating agents: Interfere with normal cell division, directly damaging DNA, causing DNA strand mutation or dysfunction (Rogers, 1986; Sorsa et al., 1985). Some examples include nitrogen mustard, cyclophosphamide, dacarbazine, cisplatin, carmustine, semustine, thiotepa, streptozocin, busulfan, chlornaphazin, chlorambucil, procarbazine, and melphalan.

Vinca alkaloids (mitotic inhibitors): Act on the mitotic apparatus necessary for cell division. Although not completely understood, it is thought that these agents bind specifically with cell protein resulting in cellular dysfunction, and cell death (Rogers, 1986; Sorsa et al., 1985). Some examples include vinblastine, vincristine, vindesine, etoposide, and teniposide.

Antimetabolites: Antagonists for the synthesis of folic acid, purines, and pyrimidines or nucleotides; interfere with DNA synthesis by binding with these components (Rogers, 1986; Sorsa et al., 1985). Some examples include fluorouracil, cytarabine, methotrexate, azathioprime, mercaptopurine, thioguanine, and azacytidine.

Antitumor antibiotics: Inhibit DNA transcription and duplication processes within the cellular genetic structure in both normal and neoplastic cells (Rogers, 1986; Sorsa et al.,

1985). Some examples include doxorubicin, bleomycin, dactinomycin, mitomycin, mitoxantrone, and daunorubicin.

In this study the following terms are defined:

Preparation of antineoplastic drugs: Mixing or reconstitution of antineoplastic drugs.

Safe Preparation of antineoplastic drugs: Mixing or reconstitution of antineoplastic drugs, including cleaning spills and breakages, in accordance with the "guidelines for the handling and disposal of cytotoxic agents and contaminated items by nurses on the hospital ward" (Cross Cancer Institute, 1986).

Administration of antineoplastic drugs: Giving or monitoring infusions; discontinuing intravenous, intra-arterial, intraperitoneal, intratumor, intrathecal, or bladder instillation antineoplastic drug equipment.

Safe Administration of antineoplastic drugs: Giving or monitoring infusions; discontinuing intravenous, intra-arterial, intraperitoneal, intratumor, intrathecal, or bladder instillation antineoplastic drug equipment in accordance with the "guidelines for the handling and disposal of cytotoxic agents and contaminated items by nurses on the hospital ward" (Cross Cancer Institute, 1986).

Utilization of personal protective equipment: The wearing of eyeglasses or goggles, a mask, a gown or gloves while preparing or administering antineoplastic agents.

Method

Subjects

Data were collected from a sample of 124 registered nurses who worked with or had a history of working with antineoplastic drugs, and who were currently employed in a single active treatment oncology setting. Of the 124 respondents, 100 nurses (80%) reported that they were currently preparing and/or administering antineoplastic drugs. Twenty- four nurses (20%) indicated that while they were not currently preparing or administering antineoplastic drugs in their work, but they had done so in the past.

Materials

A face-to-face interview schedule consisting of 94 items was constructed to investigate the possible relationships between the independent variables of oncology nurses' perceptions, and the dependent variable of the self-reported utilization of personal protective equipment during antineoplastic drug preparation and administration (Appendix B). According to the Health Belief Model, the perceptions of health or illness together with modifying factors that help or hinder action, motivate individuals to comply with a recommended health behavior or seek a healthy state. The three perceptional variables that were used to assess the nurses readiness to take action were:

1. Perceived susceptibility to illness associated with occupational exposure during preparation or administration of antineoplastic drugs (8 items).
2. Perceived severity or seriousness of potential illness resulting from antineoplastic drug preparation or administration (7 items).
3. Individual nurse's concern for health (2 items).

The modifying factors that were selected to assess the indirect influence on nurses action towards adopting safe drug handling behaviors were:

1. Perceived barriers consisting of factors which prevented or inhibited the nurse's use of personal protective equipment during antineoplastic drug exposures (5 items).
2. Demographic variables including age, sex, nursing experience, length of employment in oncology nursing, level of education, current employment department, work schedule, and whether eyeglasses were worn at work (affects eye-protection protocol). Individual characteristics surveyed in this category included reproductive health status; reported practices regarding antineoplastic drugs and other occupational exposures (ionizing radiation, anesthetic gases and chemicals); recency and workspace characteristics of drug preparation; frequency and recency in antineoplastic drug administration and spill clean-ups; and perceived deficiencies within the institutional

guidelines for the safe handling of antineoplastic drugs (43 items).

3. Structural variables - including knowledge level regarding safe antineoplastic drug handling practices and reported training and use of resources regarding safe antineoplastic drug handling practices (14 items).
4. Socio-environmental factors including co-worker use and influence on personal decision to utilize personal protective equipment (2 items).

The dependent variable of self-reported personal protective equipment usage consisted of 13 items.

Content validity of the questionnaire, was established from a review of the literature, the researcher's clinical experience in occupational health nursing, and from interviews with nurses, physicians and investigators having expertise in the fields of oncology, occupational health, and the Health Belief Model.

A respondent's booklet was developed for reference by each survey participant. The booklet contained the definitions of preparation, administration, and categories of antineoplastic drugs, as well as the scales and response options for each multiple choice question in the instrument, thus ensuring consistency in terminology and comprehension (Appendix C).

A pre-test was conducted with three oncology nurses who had administered and/or prepared antineoplastic drugs but who were not employed in the research setting, and therefore were not potential respondents. This number was considered sufficient to uncover any problems with field logistics, respondent selection, or question clarity (Backstrom & Hursh-Cesar, 1981).

Procedure

The oncology nurses names and work stations were obtained from the institution's Director of Nursing. A letter of introduction describing the purpose of the study was posted at each nursing unit, and individual letters to prospective participants were left at each nursing

unit or at the individual nurse's work station (Appendix D). The prospective nurse respondents were approached on the nursing unit to confirm their interest in participating in the study. Based on the nurse's agreement to participate, an interview time was arranged. The interviews were conducted during the nurses' scheduled tour of duty, in a consultation room on each nursing floor. The nurse and the investigator arranged the interview schedule in advance with the individual nursing unit supervisors. This procedure ensured that emergent patient care requirements could be overseen by other staff members during the participant's absence.

Prior to the actual interview, a written information sheet (Appendix E) was given to and discussed with each prospective nurse participant. The information sheet explained the purpose of the research study, and the kind of information that was requested. The administration of the questionnaire took approximately 20 - 25 minutes. By conducting the interviews near the nurses' work areas lost work time was minimized; the participant's privacy was assured; and true individual responses were elicited. Personal interviews limited the participant's opportunity to consult with nursing colleagues while responding to the questionnaire.

Ethical Considerations

Following acceptance of the research proposal from the Ethics Review Committee, Faculty of Nursing, University of Alberta, the proposal was submitted to and approved by the study's proposed institution's Nursing Research Review Committee.

Results

Presented are the outcomes of the face-to-face interviews using the Oncology Nurses' Perception Questionnaire. Descriptive statistics and content analysis, where appropriate, have been used to describe the oncology nurses' responses.

Characteristics of the Sample

A list of 146 nurses' names was provided by the institution's Director of Nursing. Of the 146 names, 134 nurses currently employed in the institution became potential respondents. Twelve nurses did not meet the study's criteria (9 nurses indicated that they had insufficient antineoplastic drug administration or preparation experience in view of the study's definitions and 3 nurses were graduate, not registered nurses). Although no one refused to participate, 124 of the potential 134 registered nurses were interviewed. Eight nurses were on leave (sick, maternity, L.O.A., vacation) and two nurses resigned between the time the list was obtained and the onset of data collection.

The sample consisted entirely of female registered nurses, having a mean age of 35.3 years (range 21- 59 years). The majority of the nurses (70%, n=87) reported being employed in a staff nurse position in either of the two largest nursing departments, an inpatient ward or the out-patient clinic. A summary of the characteristics of the sample are listed in Figures 1 - 7 and Table 1.

Figure 1.

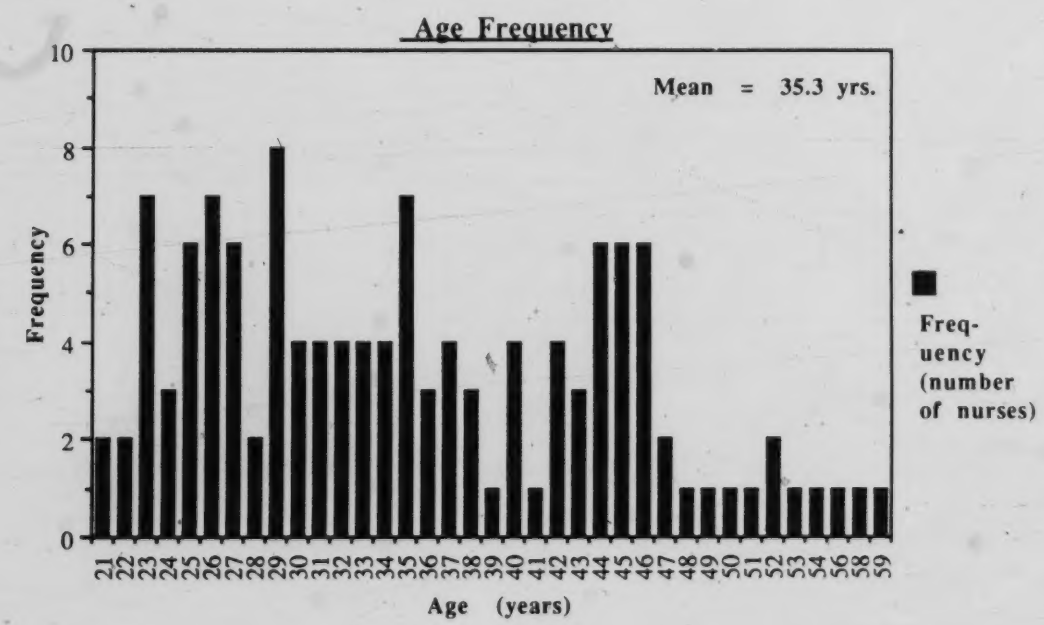


Figure 2.

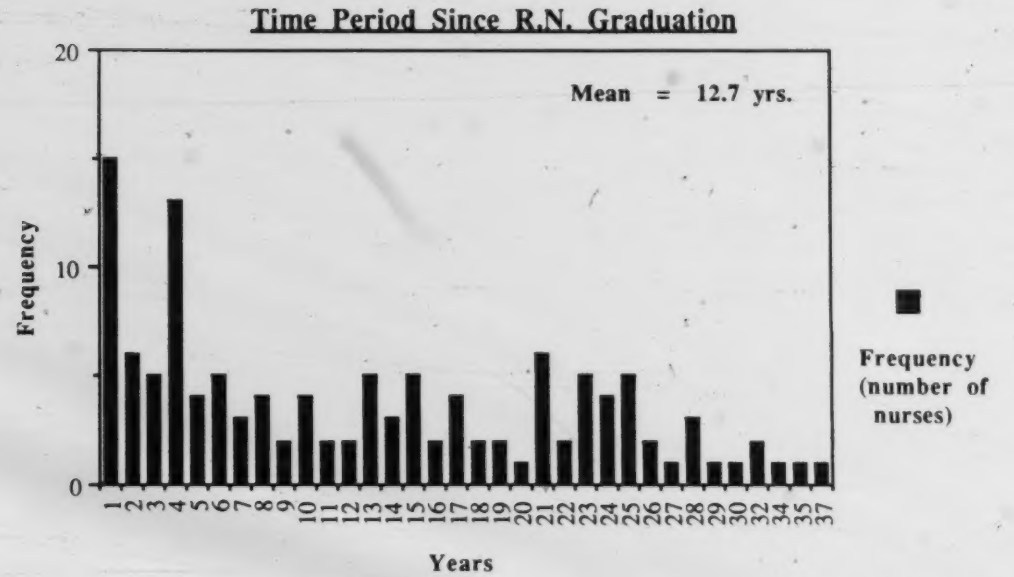

Time Period Since R.N. Graduation
Mean = 12.7 yrs.
Frequency
20
10
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 32 34 35 37
Years
Frequency (number of nurses)

Figure 3.

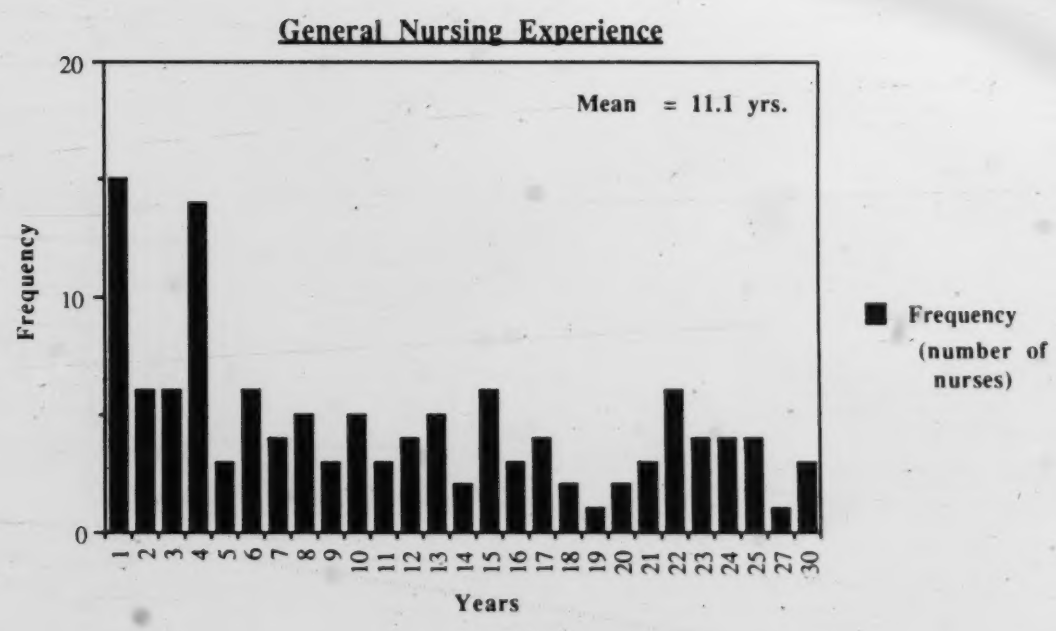

General Nursing Experience
Mean = 11.1 yrs.
Frequency
20
10
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 27 30
Years
Frequency (number of nurses)

Figure 4.

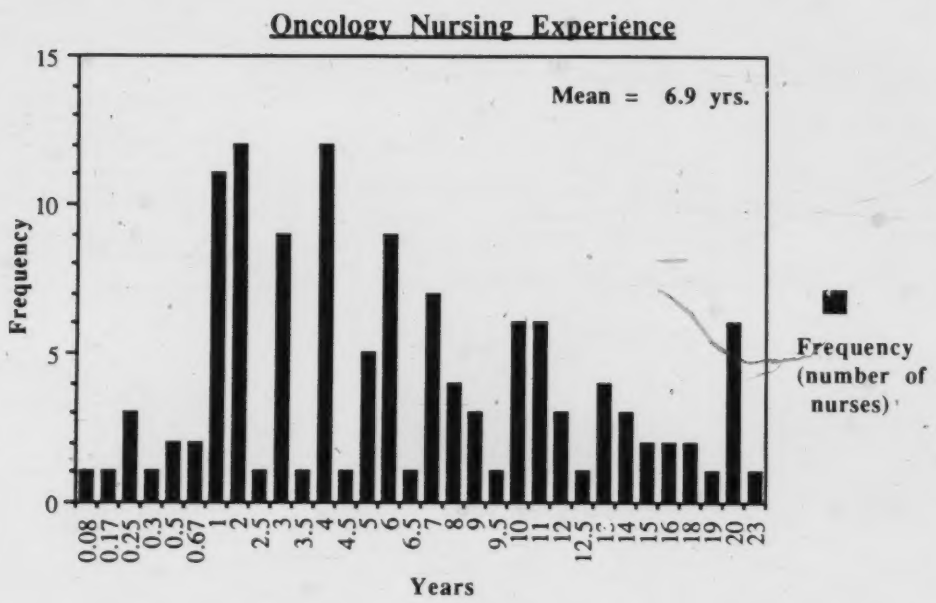


Figure 5.

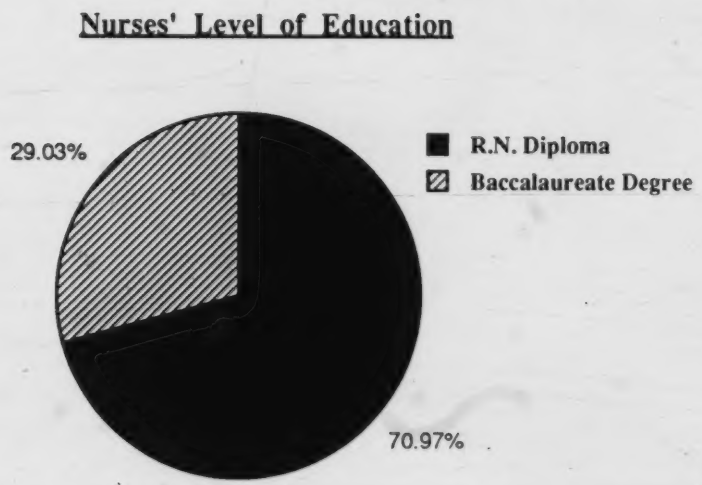


Figure 6.

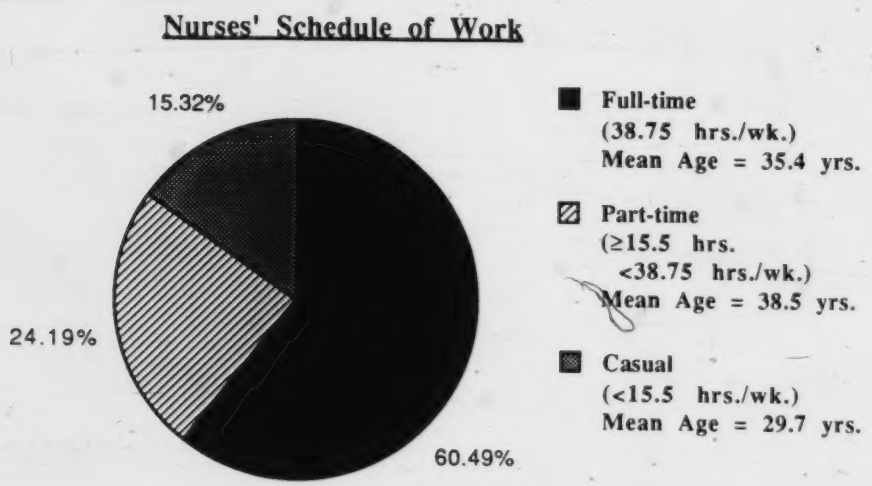


Figure 7.

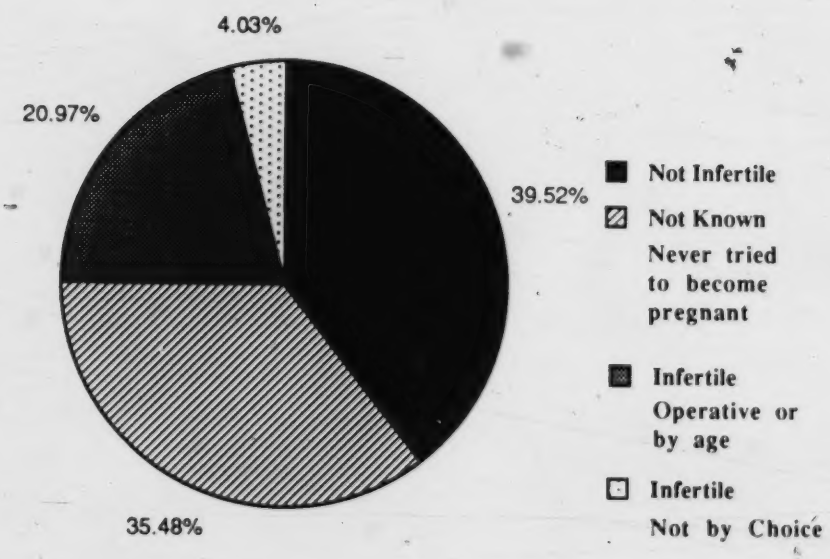


Table 1.

Additional Demographic Characteristics of the 124 Nurses

Characteristic	Frequency	
	n	%
Eyeglasses worn at work		
- yes	61	49
- no	63	51
	124	100
Department of Employment		
In-Patient Wards	83	67
Out-Patient Clinic	16	13
Clinical Research	10	8
Administration	3	2
Radiation Therapy	4	3
Education	2	2
Patient Support Services	2	2
Admitting	2	1
Occupational Health / Infection Control	1	1
Operating / Recovery Room	1	1
	124	100

Demographic Variables

Included in the demographic category were the following independent variables: age, sex, nursing experience, length of employment in oncology nursing, education, current employment department, work schedule, eyeglasses worn at work (affects eye-protection protocol) and reproductive health status. Reported practices regarding antineoplastic drug exposures were also surveyed including recency and workspace characteristics of drug preparation, frequency and recency in antineoplastic drug administration and spill clean-ups, as well as reported practices regarding other extraneous occupational exposures (ionizing radiation; anesthetic gases; chemicals), and perceived deficiencies within the institutional guidelines for the safe handling of antineoplastic drugs.

Of the 124 respondents, 24 nurses (20%) indicated that they were not currently preparing or administering antineoplastic drugs in their work, although they had in the past. The mean number of the most recent antineoplastic drug exposure was 5.6 years ago

(standard deviation 3.9). One hundred nurses (80%) reported that they were currently handling antineoplastic drugs. The nurses' mean duration of administering or preparing the drugs was 7.4 years (standard deviation 6.1). Seventy-seven nurses (62%) reported having prepared antineoplastic drugs during their career in oncology nursing; (not necessarily at the institution under study). Forty-seven nurses (38%) did not recall ever having prepared antineoplastic drugs. Of the 77 nurses who reported preparing the drugs, 12% (n=9) had prepared them within the last year, 20% (n=16) had prepared the drugs over 1 year but less than 5 years ago, and 68% (n=52) reported preparing the drugs prior to and including 1983.

In the preparation of drugs prior to and including 1983, 58% (n=30) of the nurses reported preparing antineoplastic drugs exclusively in a general medication room. The remainder (n=22) reported preparing the drugs in various areas, for example, a clean utility room, patient lounge, counter top in out-patient bay, or at the patient's bedside, in addition to a general medication room. Within the preparation areas, the safe handling practices of wearing personal protective equipment varied; 21 of the 52 respondents reported to have worn gloves, 11 reported a gown, 10 reported to have worn eyeglasses, and 8 reported to have worn a mask during drug preparation. (Combinations of personal protective equipment usage occurred, for example a nurse may have worn both gloves and eyeglasses, or gloves and a mask during drug preparation prior to and during 1983). Over 80% (n=44) of the nurses indicated that no other precautions were taken during drug preparation prior to and inclusive of 1983. Localized exhaust systems such as laminar flow hoods are located in the centralized pharmacy, and not on the patients wards. Consequently the equipment controls used to exhaust antineoplastic waste products during drug preparation have not been used by the respondents, resulting in an increased potential for exposure to antineoplastic drugs, compared with the institution's pharmacists.

In this study, antineoplastic drugs were grouped into four categories according to their chemical classification: alkylating agents; vinca alkaloids; antimetabolites and antitumor

antibiotics. The entire sample (n=124) was asked about the frequency and recency of drug administration in each category. With the exception of a few (range= 1 - 4 respondents depending on drug classification), almost all of the nurses interviewed had administered all four types. In comparing the frequency of drug administration with the four classifications of drugs, a chi-square analysis revealed no statistically significant difference (Chi-square= 2.966; df=12; p=0.05; Figure 8). As well, there was no significant difference between the types of drugs given and the recency of their administration (Chi-square=6.336; df=12; p=0.05; Figure 9). However, there was a significant difference between the time periods in which the drugs were administered. Sixty- five percent of the sample reported administering an antineoplastic drug within the past month as opposed to fewer nurses reporting administering a drug 1 - 3 years ago. (Chi-square=535.26; df=4; p=0.05; Figure 10). Specifically, the 100 nurses currently working with antineoplastic drugs, had a mean administration frequency of 5 drug doses in the week prior to being interviewed (range=0- 40 dosages; standard deviation 6.8).

Figure 8.

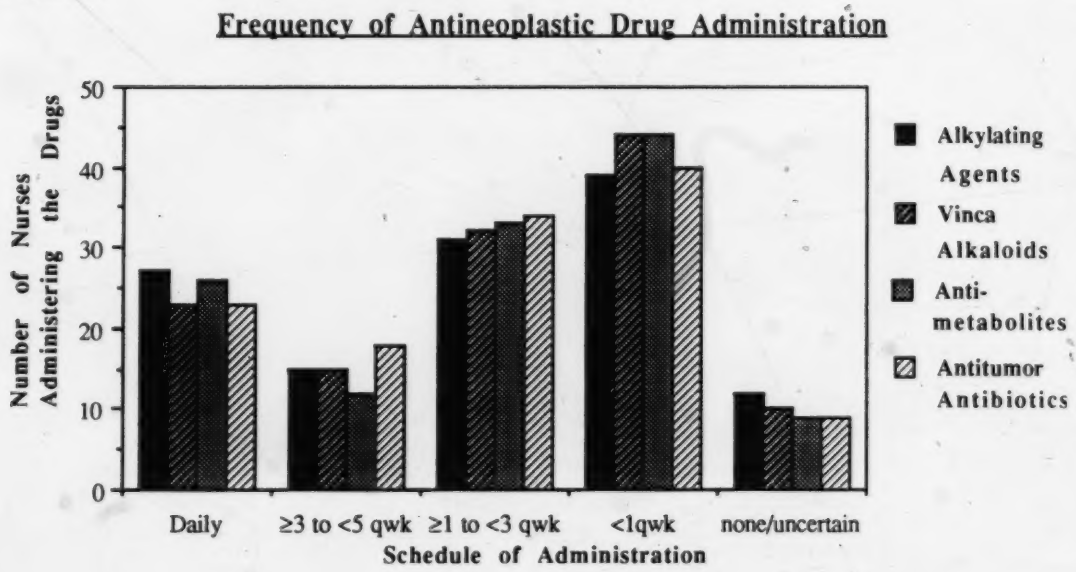


Figure 9

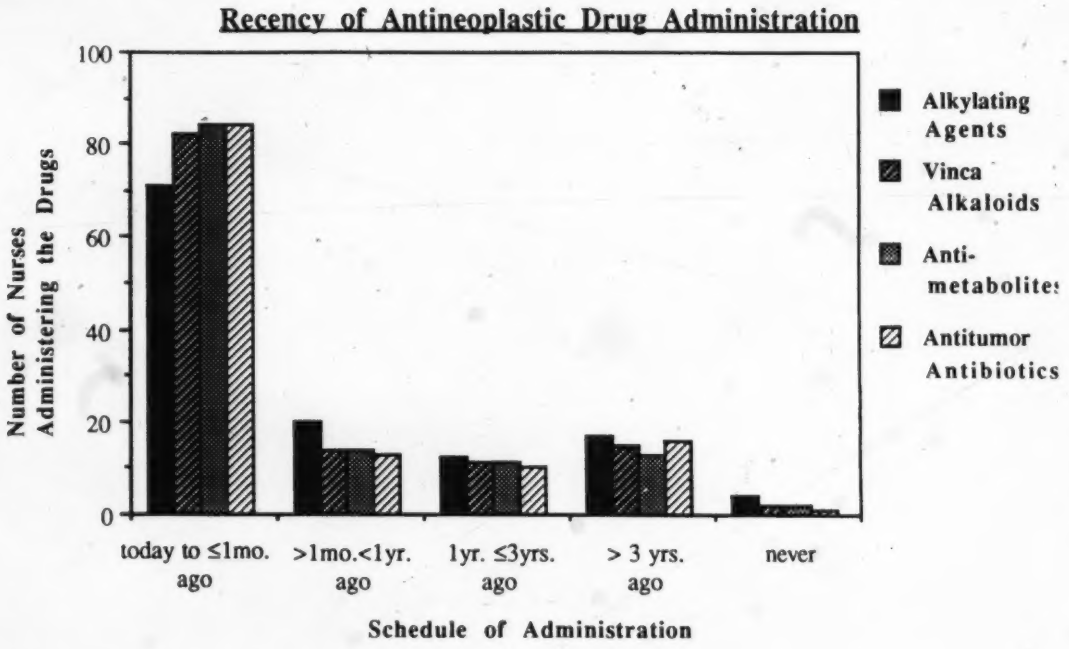
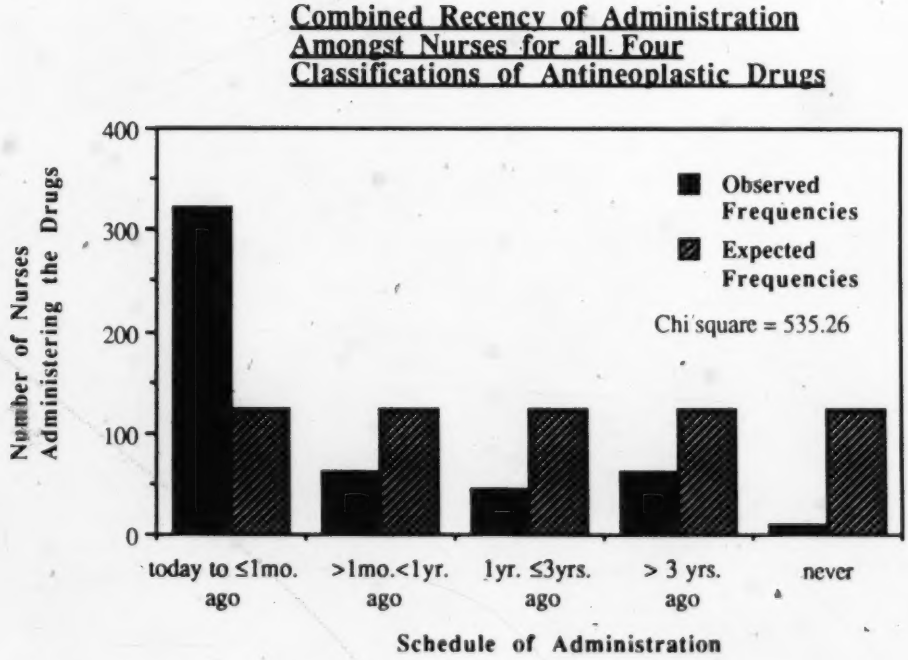


Figure 10.



Although the number of nurses potentially at risk for exposure to antineoplastic agents is large, through patient care and monitoring intravenous infusions, it was found that the job of preparing and actually administering the drugs was limited to a small number of nurses at any one period of time. On each individual in-patient ward, one nurse called the "chemo nurse" administers all antineoplastic drugs for a 3 month period, before being reassigned. Additional training is required and 71% of the sample (n=88) indicated that they had completed the necessary certification. Although this job has the potential for additional acute exposure to antineoplastic drugs, the nurses were not specifically asked if they had occupied the position of "chemo nurse." The discrepancy in the comments offered by some nurses, who despite being certified had never actually occupied the "chemo nurse" position, did not become apparent until midway through the interview schedule. Consequently, data to verify the number of nurses certified and never occupying the position was not collected.

Among nurses currently working with antineoplastic drugs, 20% (n=25) indicated that they had cleaned up an antineoplastic drug spill in the last year. The number of spills cleaned during the year did not exceed four. Sixty-five percent (n=81) of the nurses reported having had antineoplastic drugs on their skin and 11% (n=14) of the nurses have had antineoplastic drugs in their eyes at some point in their nursing career. Other extraneous occupational exposures that were explored included ionizing radiation, anesthetic gases and chemicals (Figures 11 - 15). Almost all of the 109 nurses (n=100) who reported being occupationally exposed to ionizing radiation wore protective equipment, such as a leaded apron or shielded themselves behind a lead barrier. Forty-nine percent of the sample who reported chemical exposure wore gloves (n=57/117). Forty percent of the 93 nurses (n=37) who reported exposure to anesthetic gases during their nursing career, reported the presence of ventilation to control waste gases in the area.

Figure 11.

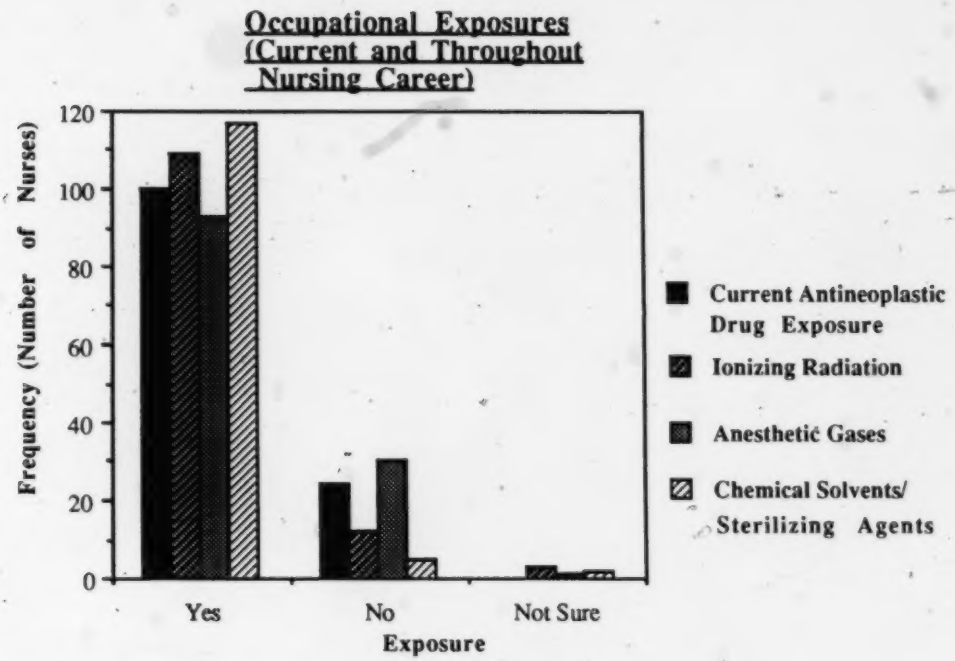


Figure 12.

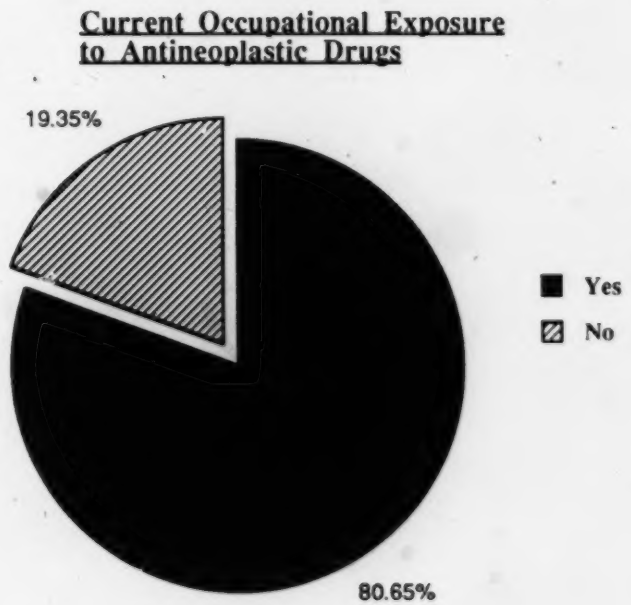


Figure 13.

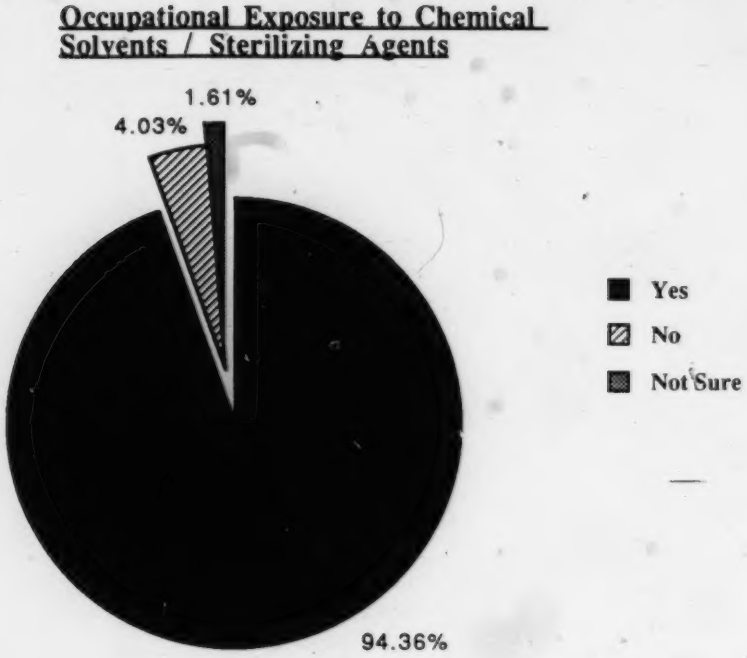


Figure 14.

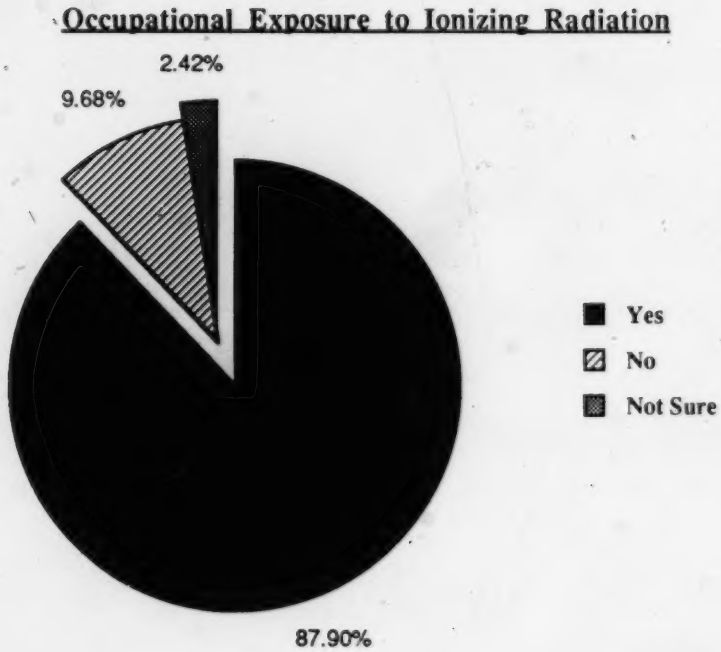
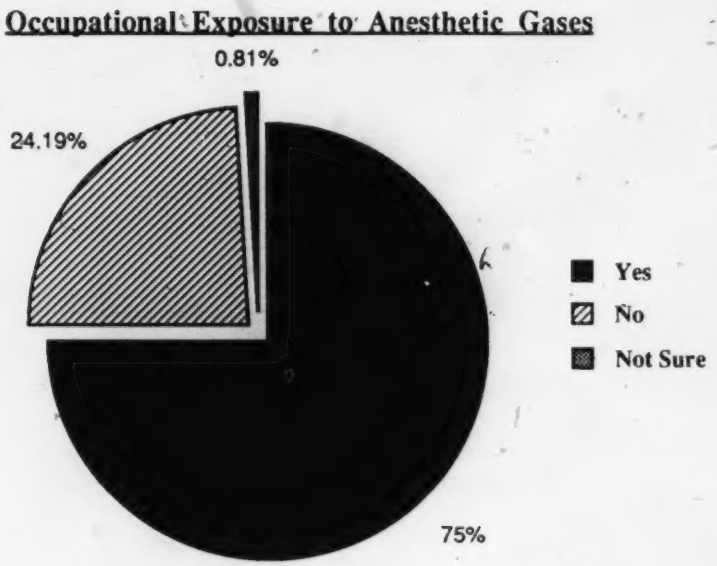


Figure 15.



Regarding the institution's guidelines for the safe handling of antineoplastic drugs, 21% (n= 26) of the respondents indicated that the guidelines were deficient in six areas, and recommended changes for improvement. Forty-two percent (n=11) of the 26 respondents wanted more information on the health effects antineoplastic drug exposures have on health care workers. Twenty-seven percent (n=7) wanted better availability and accessibility to the guidelines. The remainder (n=8) desired changes in the guideline's format, for example, more pharmacologic material on how the drugs work; emergency measures for chemotherapeutic drug-induced anaphylaxis; demonstrations rather than written guidelines regarding spill clean-ups, as well as increased antineoplastic drug preparation information.

Oncology Nurses Perceptions (Perceived Susceptibility and Severity)

Nurses were interviewed regarding the perceived likelihood of contracting each of seven conditions as a result of preparing or administering antineoplastic drugs. Using a 7-point scale, respondents were asked to rate perceived susceptibility to each condition. Nurses who rated susceptibility as 4 or more, were asked to report perceived severity of the condition. Susceptibility to skin rash ranked the highest, with 21% of the sample (n=26) reporting a mean susceptibility rate of 5.7 (standard deviation 1.1) and a severity rate of 3.8 (standard deviation 1.8). The number of nurses reporting perceptions of increased susceptibility to illness, cancer and miscarriage followed closely. The lowest category of perceived susceptibility was dizziness, reported by two of the nurses (mean susceptibility 5, standard deviation 1.4; mean severity 4.5, standard deviation 0.71). Moderate relationships were found between the perceptions of increased susceptibility to illness and severity of the illness ($r=0.407$; $p=0.02$; $n=25$); and the susceptibility of a miscarriage and its severity ($r=0.418$; $p=0.03$; $n=21$). The remaining conditions could not be correlated using Spearman's rho computation, as the number of nurses in each category was too small. Figure 16 summarizes the perceived susceptibility of the various conditions. Of the people who reported 4 or more rates of perceived susceptibility, the mean severity rates by condition can be found in Figure 17. During the interview, when susceptibility was posed objectively in the third person, instead of subjectively, approximately 69% of the sample (n=83), perceived that a nurse would be at risk for a health problem if gloves were not worn while preparing or administering antineoplastic drugs.

Figure 16.

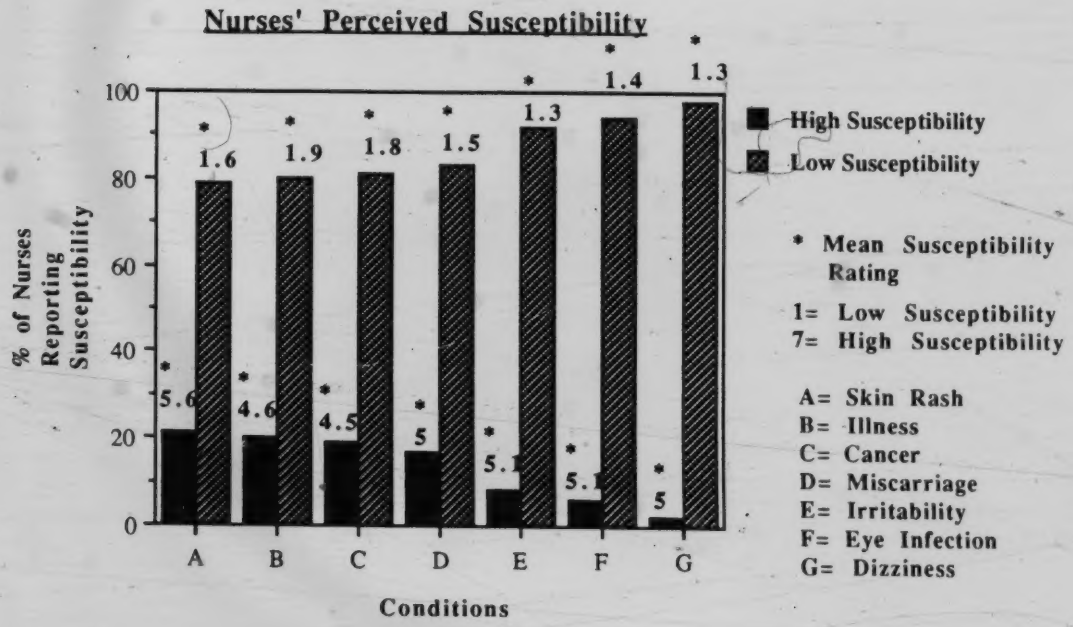
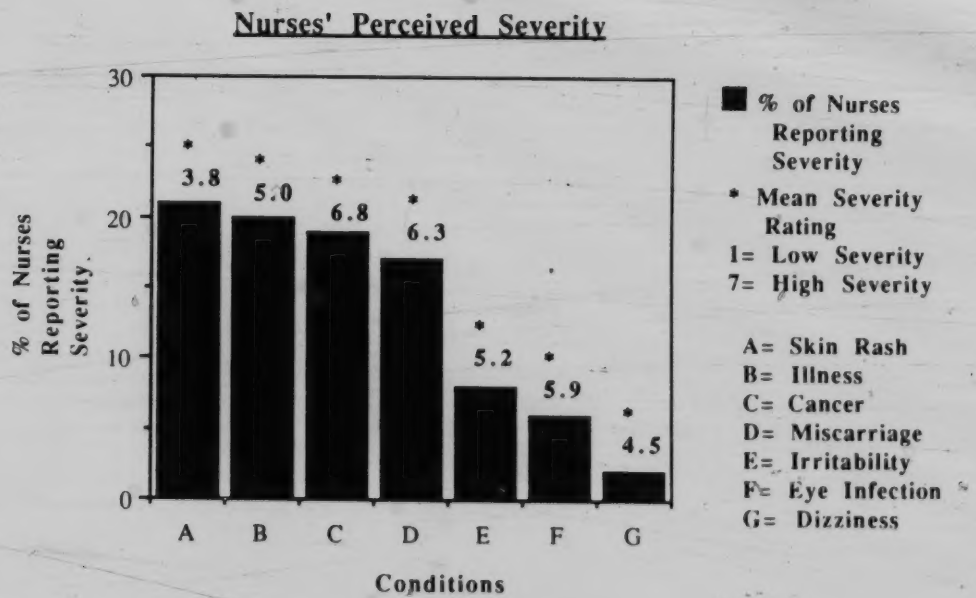


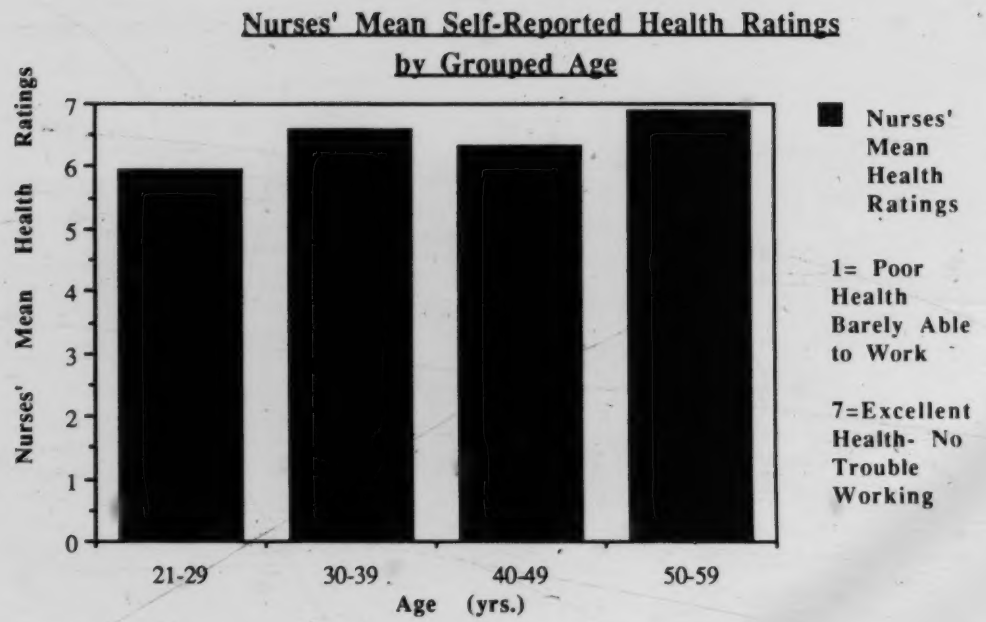
Figure 17.



Concern for Health

Respondents were asked to rate their general health from 1 to 7 (1=poor health-barely able to work, 7=excellent health-no trouble working). Eighty-six percent (n=107) rated their health as 6 or 7. Ten percent (n=12) reported their health as 5, and the remaining 4% (n=5) reported 2-4. A one-way analysis of variance (ANOVA) determined a significant difference between the nurse's self-reported health status and their age ($F=4.68$; $df=3,120$; $p=0.004$). The youngest nurses, being in the 21-29 year age group (n=43; 35% of the sample) had the lowest mean health rating of 5.9 compared with the rest of the study respondents. Nurses in the 30-39 year category (n=38; 31% of the sample) had a mean health rating of 6.6. Nurses in the 40-49 year category (n=34; 27% of the sample) had a mean health rating of 6.3. Nurses in the 50-59 year category (n=9; 7% of the sample) had the highest mean health rating of all the nurse respondents (6.9). The mean health ratings of respondents in the 21-29 years age group was skewed by a small number of nurses with unusually low self-reported health status. A weak, although significant relationship between health and age was calculated using the Spearman rho statistic ($r=0.243$; $p=.003$; $n=124$). Figure 18 illustrates the nurses mean self-reported health ratings by grouped age category.

Figure 18.



Perceived Barriers

The nurses' perceptions of barriers that prevented or inhibited them from undertaking health-related behaviors were evaluated by open-ended questions. Qualitative analyses were applied in the classification of factors which hindered the use of personal protective equipment during antineoplastic drug administration and spill clean-up procedures.

Ten percent of the nurses currently handling antineoplastic drugs (n=10), indicated that they had not consistently worn gloves during the drug dosages administered in the week prior to being interviewed. Three stated that they "were in a hurry and could not be bothered." Two nurses cited personal preference as gloves "inhibit the delivery of patient care." Three nurses were not in the habit of wearing gloves; stated that they "did not feel at risk as they were past childbearing age and experienced less drug leakage compared with mixing in 1981." The remainder mentioned specific problems with the gloves, for example, only large sizes were in stock.

In the investigation of spill clean-up practices, 20% (n=25) of the sample indicated that they had cleaned from one to four antineoplastic drug spills in the last year. Nine percent of the sample (n=11) reported the greatest difficulty in wearing eyeglasses or eyegoggles to clean up a spill. The second most frequently reported barrier was to the use of masks (n=10; 8% of sample). The third most frequently reported barrier was to the use of gowns (n=7; 6% of sample). Barriers to gloves was the most infrequent restriction reported during the clean-up of spills. Only one respondent reported not wearing gloves as she "felt risk free by using incontinent pads and avoiding skin contact during cleaning."

Regarding the overall factors hindering equipment use during the 31 spill clean-ups, the nurses reported not wearing either eyeglasses, masks, gowns, or gloves in 45 instances. In 34% of the omissions (n=15) the nurses cited being "not at risk as the spills were small." In 31% of the cases (n=14), the nurses indicated that the "gowns or masks were not conveniently accessible at the spill site"; 20% (n=9) of the cases the nurses reported "being in a hurry." In the remaining 15% of the cases (n=7), the nurses stated that they were "not in the habit of wearing the particular piece of equipment" or cited perceived equipment difficulties ie. that the "eyegoggles were too big and obscured vision."

Structural Variables (Knowledge of Safe Antineoplastic Drug Handling Practices)

Regarding the knowledge of antineoplastic drug handling, the nurses were asked what action was to be taken if antineoplastic drugs came in contact with their skin and where antineoplastic drug wastes and equipment were to be discarded as written in the hospital's policy guidelines. Sixty-six percent of the respondents (n=82) knew the correct procedure, as outlined in the institution's guidelines (to wash it off). The remaining 34% (n=42) would rinse or flush the skin. All the nurses knew the hospital's policy for antineoplastic drug waste disposal. Few nurses (n=6) were not aware that the hospital had guidelines for the preparation and administration of antineoplastic drugs. The mean self-

reported knowledge of the guidelines on a scale of 1 to 7 (1=do not know, 7=know very well) was 5 (standard deviation 1.5).

Nurses were asked to report on the various drug training courses that they had attended. Seventy-one percent of the sample (n=88) had attended inservice training on antineoplastic drugs, or had completed the institution's advanced chemotherapy teaching program. Almost all of the nurses had read journal articles related to antineoplastic drugs (n=106), and 42% (n=52) had attended related seminars and conferences outside of the institution. Ninety-eight percent of the respondents (n=121), recalled receiving training in the administration of antineoplastic drugs, and 65% (n=80) recalled training in the preparation of the drugs. Thirty-five percent of the nurses (n=43) did not recall receiving information in the potential health effects to health care workers from exposure to antineoplastic agents. In the following areas an average of 90% of the nurses received training (n=114). Training included the disposal of antineoplastic waste materials; use of personal protective equipment such as gloves, gown, mask and eyeglasses; skin contact and spill clean-up procedures.

Socio-environmental Factors

Over 90% of the nurses interviewed (n=113) indicated that their co-workers had always or frequently worn gloves while administering antineoplastic drugs. Thirty-seven percent of the sample, however stated that their co-workers had no influence in their decision to wear gloves while administering antineoplastic drugs (n=46); 22% (n=27) indicated that their co-workers had a great deal of influence. The remaining 41% (n=51) indicated a range of co-worker influence from a "little" (n=17), to "moderate" (n=13), to "quite a bit" (n=21). Age was not a factor in co-worker influence on equipment usage. There was no significant age difference between the nurses who were influenced a great deal by their co-workers and those who were not ($F=0.762$; $df=4,118$; $p=0.552$).

Dependent Variable- The Oncology Nurses Utilization of Personal Protective Equipment

The "guidelines for the safe handling and disposal of cytotoxic agents and contaminated items by nurses on the hospital ward" specify that closed-front long sleeve gowns with tight-fitting cuffs and neck, high filtration disposable face masks, disposable gloves and safety goggles or regular eyeglasses are to be worn during antineoplastic drug preparation or spill clean-ups. During drug administration, disposable latex gloves are to be worn (Cross Cancer Institute, 1986).

Thirteen questions were asked about personal protective equipment usage during the preparation, administration and spill clean-ups of antineoplastic drugs. The sample of nurses answered a mean number of 8 questions (standard deviation 7.0). To determine the extent to which nurses reported using eyeglasses, masks, gowns, or gloves, a ratio was calculated between the total score for equipment use and the number of questions answered. Of the questions answered, personal protective equipment including gloves, gowns, masks or eyeglasses were worn in an average of 77% of the cases (mean 0.765; standard deviation 0.221).

Nurses were also asked to recall their specific drug preparation practices concerning the use of personal protective equipment. Seven percent of the sample (n=9) had prepared an antineoplastic drug in the last year. All of the nurses reported that gloves had been worn during drug preparation, eyeglasses and a gown were worn most of the time, and a mask was worn in about one-half of the cases.

An overall personal protective equipment utilization ratio was computed for the 100 nurses currently administering antineoplastic drugs. The data showed that on average, gloves were worn in 9 of the 10 antineoplastic drug dosages administered in the week prior to being interviewed (mean= 0.907; standard deviation 0.262).

Among nurses currently working with antineoplastic drugs, 20% (n=25) indicated that they had cleaned up an antineoplastic drug spill in the last year. The reported number of spills cleaned during the year totalled 31, however individual exposures did not exceed

four. Of the spill clean-ups, all but one nurse wore gloves (n=24), 72% (n=18) wore a gown, 60% (n=15) wore a mask, and 56% (n=14) wore eyeglasses or eyegoggles. Combinations of personal protective equipment were reportedly worn during the 31 spill clean-ups. Glove usage was the most frequent (n=27), followed by the use of gowns (n=19). Eyeglasses or goggles and masks were reportedly worn in approximately one-half of the spills cleaned (n=17; n=16).

Responses to Research Questions

Pearson Correlation Coefficient statistics were computed for the first five research questions, and one-way analysis of variance (ANOVA) for portions of the fourth and remaining questions. The criteria for interpreting the statistical values in survey research were supported by Backstrom and Hursh-Cesar (1981).

The first question regarding the nurses' perceived susceptibility being related to personal protective equipment utilization was supported by the data. A low positive correlation was found (r=0.208; p=0.014; n=111).

The second question relating the nurses perceived severity of health effects to personal protective equipment use was not supported (r=0.115; p=0.208; n=52).

The third question regarding the nurse's reported level of health and utilization of personal protective equipment indicated a weak, although significant negative correlation between the two variables (r=-0.181; p=0.029; n=111). As the nurse's reported level of health increased, the utilization of personal protective equipment decreased.

The fourth question regarding the demographic variables being associated with personal protective equipment utilization during antineoplastic drug preparation or administration revealed a low but significant negative correlation in the oncology nurse's age (r=-0.274; p=0.002; n=111). A substantial negative correlation was found in the equipment utilization and years of oncology nursing experience (r=-0.501; p=0.000; n=111). General nursing experience also revealed a definite negative correlation with

equipment use (r=-0.335; p=0.000; n=111). An increase in the nurse's age and years of experience corresponded inversely with a decrease in the utilization of personal protective equipment.

Additional demographic variables and individual characteristics analyzed included the level of nursing education, current job and reproductive health status. There was no significant difference in reported equipment use between the R.N. Diploma and the Baccalaureate prepared nurses (F=1.432; df=1,109; p=0.234). Conversely, there was a significant difference in reported equipment use between nurses who were employed in staff nurse positions and those who worked in nursing administration, education, or clinical research (F=5.528; df=1,109; p=0.021). Nurses who identified their job as working in a staff nurse position giving direct patient care (n=76) had a higher reported use of personal protective equipment (mean 0.798; standard deviation 0.224) than nurses who reported being employed in nursing administration, education, or clinical research (n=35; mean 0.694; standard deviation 0.199). There was no significant difference in reported equipment use between the four classifications of nurses' self-reported reproductive health status (F=0.425; df=2,108 p=0.655). Fertility did not appear to be a significant factor in reported utilization of personal protective equipment.

The fifth question regarding the oncology nurse's level of knowledge regarding the safe preparation and administration of antineoplastic drugs, and the utilization of personal protective equipment use was not supported (r=0.061; p=0.261; n=111).

The sixth question regarding accidental skin contact with antineoplastic drugs influencing subsequent use of personal protective equipment during antineoplastic drug preparation and administration was not supported. There appeared to be no difference in equipment use by nurses who had spilt drugs on their skin and those who had not. (F=0.626; df=1,109; p=0.431).

The seventh question pertaining to the nurses who reported being influenced a great deal by co-workers in their decision to wear personal protective equipment during antineoplastic drug preparation or administration, differing from those nurses who are influenced to a lesser extent, was not supported. The difference was not significant ($F=0.164$; $df=4,105$; $p=0.956$).

Discussion

Within this study, the responses to interview questions corresponding to variables of the Health Belief Model: perceived susceptibility, self-reported health status, years of oncology and general nursing experience, and age were all significantly associated with personal protective equipment usage. The nurses who regarded themselves as susceptible to adverse health conditions as a result of preparing or administering antineoplastic drugs were those more likely to follow safe handling practices, specifically, to comply with wearing personal protective equipment. Nurses who reported a high level of health reported a low level of equipment utilization. An increase in the nurse's age was inversely associated with a decrease in utilization of personal protective equipment. The significant positive correlation of perceived susceptibility and equipment utilization is consistent with the literature. A critical review of 46 studies related to the Health Belief Model has suggested that "perceived susceptibility" is a significant contributor in understanding preventive health behavior (Janz & Becker, 1974).

In this study, only 50.5% of the variability in the utilization of personal protective equipment was accounted for by the years of oncology nursing experience (25%), general nursing experience (11%), the nurse's age (7.5%), perceived susceptibility (4%), and general health (3%). The application of the Health Belief Model in this study was inadequate. Despite the omission of key variables such as perceived benefits and efficacy, the findings confirm that a different framework or methodology may be more appropriate. A framework that incorporates the elements of the importance of health, perceived control

and degree of perceived self-efficacy would appear to be better suited to the study of personal protective behaviors of nurses working with antineoplastic drugs. Pender has incorporated these elements into a Health-Promoting Model, and an adaptation of such an efficacious model is recommended (Pender,1987, p.57).

The factors that failed to indicate a significant relationship with the use of personal protective equipment included perceived severity, knowledge of safe preparation and administration practices, extent of co-worker influence and accidental skin exposure. As in other studies (Feuerstein et al., 1986; Janz & Becker, 1974; Leventhal et al., 1984), no significant relationship was found between perceived severity and the adoption of preventive health practices. Perceived severity is more strongly related to "sick-role behaviors" [actions taken after the diagnosis of a disease to restore good health or prevent further disability] rather than "preventive health behaviors" [actions taken to avoid illness or injury] that were investigated in this study (Janz & Becker). Despite the fact that 65% of the respondents reported having had antineoplastic drugs on their skin, the experience apparently was not significant in influencing subsequent safe handling of the drugs.

Ninety percent of the nurses (n=112) indicated that they perceived others as "always" or "frequently" wearing gloves while administering antineoplastic drugs. In the self-reports of nurses administering drug dosages, gloves were worn in 9 of the 10 doses administered the week prior to being interviewed. Therefore there was an apparent consistency with the observation of the behavior of others in using gloves. Objective and subjective comparisons were not examined in eyeglasses or goggles, masks, or gowns as their reported use was less frequent.

This study's findings confirmed those of the previous investigations regarding glove use during antineoplastic drug preparation. Valanis and Shortridge (1985) revealed an increase in glove utilization of more than 2 1/2 times over Crudi et al. (1981). In this study, only 40% of the 52 respondents reported wearing gloves during drug preparation

prior to and including 1983, whereas all of the nurses (n=9) reported wearing gloves during preparation in 1988. The increase in reported glove utilization may have been motivated by other health care concerns, such as Hepatitis B and the Human Immunodeficiency Virus, and may be associated with an increased compliance with the institution's safe practice guidelines. This factor should be explored further in subsequent research investigations.

One could speculate that the reduction in the number of people currently preparing antineoplastic drugs occurred as a result of the publication of safe drug handling guidelines. The guidelines recommend that in addition to limiting the number of people preparing the drugs on a regular basis, antineoplastic drugs should be prepared only in specialized areas. For example, in the study institution antineoplastic drugs are prepared by pharmacists in the centralized pharmacy, within vertical flow biological safety cabinets.

An increased awareness regarding the potential health hazards of antineoplastic drug exposures is regarded by the American National Study Commission on cytotoxic exposure as a major factor contributing to increased protective equipment utilization (Gallina, 1988). Just because nurses are made aware of potential health effects, does not mean that they will act on the information. There is a difference between "general awareness" and "awareness as it relates to the self." This difference was a major constraint in the adaptation of the Health Belief Model in this study. "Self-awareness" is not an explicit variable of the Health Belief Model, and therefore could not be measured. A measure of the extent of "awareness internalization" could be explored through a health-promoting framework by the question: How does the information of potential health effects affect you and what are you going to do about it?

It was evident from this study that the nurse's level of knowledge regarding the safe preparation and administration of antineoplastic drugs was not associated with personal protective equipment usage. Internalization of the consequences of not wearing personal

protective equipment may be an important key in influencing such behavior and merits further investigation.

A significant discrepancy was found between the age of oncology nurses and their reported levels of health. Eighty-six percent (n=107) rated their health as good or excellent, while 4% (n=5) reported poor health. The youngest nurses in the 21-29 year age group (n=43; 35% of the sample) had the lowest mean health rating of 5.9, compared with the rest of the study's respondents. Nurses in the 50-59 year category (n=9; 7% of the sample) had the highest mean health rating of all the nurse respondents (6.9). The surprisingly low mean health ratings for the youngest nurses are a result of a small but "unhealthy" group which caused a skewed distribution of the few nurses in the 21-29 age group who reported such extreme ratings. Calculation of the sample's median would have been more representative, and would have been less sensitive to extreme values than the mean reported health ratings.

This small but self-reported "unhealthy" group of young nurses appears to contradict the idea that women must be healthy to enter and remain employed in the labor force (Polit & Hungler, 1983). Several studies have cited that younger women report higher levels of health and health behaviors than older women, as well as physical health concerns being increased with age (Calnan & Rutter, 1986; Hibbard, 1988; Hibbard & Pope, 1987; MacRae & Johnson, 1986). However, Pearlin (1980), found that younger workers are more likely than older workers, to experience work pressure, alienating relations with co-workers and supervisors, and overt emotional or physical reactions to occupationally induced stress may emerge after only a moderate period of employment. Pearlin found that younger workers considered an unpleasant work situation to be a reflection of personal inadequacy, rather than an expected aspect of establishing a job or career.

Brown, in a study to determine the "hardiness" of full-time critical care and obstetrical nurses in selected hospitals in Edmonton, Alberta reported that older nurses rated their

level of well-being higher than younger nurses ($r=0.159$; $p\leq0.05$). Nurses with more experience in their specialty had better perceived well-being ($r=0.164$; $p\leq0.05$) (1988). These findings Brown suggests, "demonstrates the vulnerability of younger nurses and the need for strategies to promote their health and job satisfaction" (p.104).

"Perceived self-efficacy" a variable in Pender's revised Health Promotion Model, may assist in clarifying these findings in future studies. Older nurses may have a strong sense of efficacy, "a personal conviction that they can successfully execute the required behavior necessary to master problems or challenges" (Pender, 1987, p.62). Younger nurses on the other hand, may have to confront changes associated with the establishment, interruption or advancement of a career. Younger people in the workforce are more often vulnerable to occupational insecurities and work disruptions as the "world of labor may become gentler with age" (Pearlin, 1980, p.181). The role of perceptions of self-efficacy in motivating initiation and continuation of health behaviors needs further investigation (Pender).

In the absence of further information, it cannot be determined whether these same factors are present in this group of oncology nurses. However, there is a case to be made for evaluating the variables of job stress, one's initial nursing job, the specialized knowledge needed to work with chemotherapeutic agents and terminally ill patients, combined with the non-occupational social and domestic pressures to determine their possible contribution towards the oncology nurse's perceived health status.

Implications for Oncology Nursing Practice

Implications for application of this study's findings to this group of oncology nurses would suggest that since perceived susceptibility is the only variable that is positively correlated with personal protective equipment use and only accounts for 4% of the variability in this sample, the manner in which perceived susceptibility could be increased to correspond with increased reports of equipment use could be determined.

Alternatively the significant variables that were negatively correlated with personal protective equipment use accounted for 46.5% of the variability in this sample. One may question: Why do oncology nurses sampled report less frequent equipment use as they gain experience in their speciality and get older, than younger nurses with less experience? Could it be that the older, more experienced nurses do not feel at risk for potential health effects, so they report wearing personal protective equipment less?

A recommendation for further consideration would be to analyze perceived susceptibility within an environmental risk analysis context. One theorem plots environmental risk as a mnemonic in which risk = hazard + emotional response (F.J. Szumlas, 1989). If "perceived susceptibility" is accepted as being synonymous with the word "risk" then "perceived susceptibility" would be the summation of "the hazard" plus "the emotional response."

Perceived susceptibility would be increased by confirming the potential health hazards of antineoplastic drug handling, as the current literature is inconclusive regarding chronic low-level occupational exposure. Alternatively the identification of the factors which impact on, and increase the nurses' emotional response to their occupational exposure to antineoplastic drugs would increase perceived susceptibility. Since either increasing the hazard or increasing the emotional response or increasing both would increase perceived susceptibility, then it follows that reported personal protective equipment utilization would also increase.

Further implications of this study's findings relate to the institute's procedural guidelines for nurses handling cytotoxic agents. There was a discrepancy in the way in which the nurses reported dealing with an accidental antineoplastic drug skin contact. Two-thirds of the respondents indicated that they would wash the area with soap and water, whereas one-third would rinse or flush the area with water. The confusion could be eliminated by the nursing administration, through the revision of the nursing procedure

manual which currently reads "immediately wash the drug away with large volumes of water" (Cross Cancer Institute, 1986). The term "wash" should be clarified in the manual's guidelines. Does "wash" imply soap, or is one to flush the drug away with just large volumes of water?

The institution's orientation training program appears to be extensive for new staff, and those who elect to take the advanced chemotherapy training course. However, the data suggest that continued training of nurses to meet their requests for additional information on the potential health hazards of antineoplastic drug exposure and demonstrations of safe work practices could go far to alter poor work habits that may set in after initial periods of training. This implication resulted from perceived guideline deficiencies reported by 21% of the nurse respondents (n=26).

The use of a conceptual framework, the Health Belief Model, was meant to strengthen the generalizability and utility of this study's findings to other samples of oncology nurses. However, the relationships between the independent and dependent variables were weak and must be attributed to other factors.

"Strictly speaking, the findings of a study can only be generalized to the population of subjects from which a study sample has been randomly selected" (Polit & Hungler,1983). Although the majority of oncology nurses are female, and similar policy guidelines regarding the safe preparation and administration of antineoplastic drugs exist in other active treatment settings, the population of oncology nurses in this study may not be representative of all oncology nurses. For example, oncology nurses in general hospitals may not have the same frequency of antineoplastic drug preparation and administration practices. As well, the training program and certification requirements may differ. This study's findings would have to be replicated in a new setting and with new subjects in order to determine whether the characteristics of antineoplastic drug preparation and administration and the use of personal protective equipment are similar. The sample of

oncology nurses in this study however, did provide a baseline of reported antineoplastic drug practices, and opened up new insights into a relatively unknown topic. It may be considered a preliminary exploration of the perception variables associated with utilization of personal protective equipment.

Although studies have conflicting evidence on the relationships between urine mutagenicity, chromosomal abnormalities and long-term health effects to health professionals occupationally exposed to antineoplastic drugs, what a nurse does or does not do may have a profound effect on future health status. Leventhal et al. (1984) cites "Bem's self-perception theory", which suggests that the observation of one's own behavior may affect subsequent behavior, attitudes and beliefs. Implied is a feedback system that encourages appraisal and strategy adjustment (p.407). As the personal interviews progressed, it became apparent that the questionnaire required the oncology nurse to focus on her own antineoplastic drug handling practices, particularly in light of the recommended antineoplastic drug handling practices. In reference to the interview questions such as: How many antineoplastic drug dosages did you administer in your work last week, and of these dosages how many times did you wear gloves? If eyeglasses, a mask, gown or gloves were not worn, what kinds of things kept you from wearing this equipment some of the time? If the nurse worked with chemicals such as sterilizing agents or solvents, or was exposed to ionizing radiation in her career, was protective equipment like gloves or leaded aprons worn? Given that the interview schedule covered recent as well as past events, it made the researcher conclude that the interview may have resulted in a "consciousness raising" initiating an ongoing appraisal process.

While this study has established a baseline for this sample of oncology nurses' antineoplastic drug handling practices, perceptions and knowledge; it has the potential for increasing nursing, hospital administration, and public awareness by focusing on the factors that are part of the oncology nurse's working lifestyle, such as the potential health

risks from occupational exposures inherent in the oncological setting. The increased awareness resulting from the publication of these findings will contribute to the nursing community, the hospital administration and the interested public's understanding of the processes involved in nurses adherence to recommended safe work practices that aim at health risk reduction, maintenance of health, and illness prevention. Continued emphasis on inservice education throughout the career of the oncology nurse is required to ensure that safe work practices are reinforced and maintained.

Implications for Occupational Health Nurses in Oncology Settings

Although this study did not turn out to be an adequate test of the Health Belief Model, in that not all the variables were represented in the instrument, the lack of strong associations between the oncology nurses' perceptions of antineoplastic drug handling and personal protective equipment utilization raises questions regarding the suitability of the Health Belief Model for this particular research area, specifically the exploration of health-promoting behaviors.

The Health Belief Model focuses on specific preventive behaviors for particular diseases. The model is "disease specific and has a clear-cut avoidance orientation" (Pender, 1982, p.60). That is to say that the motivation to seek health behaviors is conducted under uncertainty to avoid an anticipated negative outcome or health threat. The health effects from antineoplastic drug preparation and administration on the other hand are not specific or certain to occur. The long-term health effects resulting from low-level occupational exposures are unknown. Consequently, based on this study's findings, the occupational health nurse should explore models for health-promoting behaviors versus models for health-protecting behaviors.

Occupational health nurses promote the health and well-being of employees. No longer is it acceptable to workers to be told to adapt to the potential hazards in the workplace. Models relating to health threats that rely on avoidance behaviors to adapt and

survive in the occupational health setting are therefore not applicable, as confirmed by this study, in which correlations were weak or absent between the independent variables and the dependent variable.

Research into health-promoting behaviors has identified several other important variables, including the perceived desire for control of health, the importance of health and the degree of perceived self-efficacy. Defining health as adaptation or stability would, in this conceptualization, predispose individuals toward health-protecting behaviors directed at avoiding illness and disease. On the other hand, defining health as "high-level wellness," in which an individual is self-directed to function at an optimal level in a constantly changing environment, would predispose one toward adopting health-promoting behaviors (Pender, 1987). "Since how goals are defined often determines the means used to achieve them, differences in definitions of health should result in differing patterns of health behaviors" (Pender, p.63).

Pender (1987) proposes that "health is the actualization of inherent and acquired human potential through goal directed behavior, competent self-care, and satisfying relationships with others while adjustments are made as needed to maintain structural integrity and harmony with the environment" (p.27). This definition of health incorporates both the stabilizing, health-protective qualities, as well as the actualizing, health-promoting characteristics which are embodied in occupational health care. Occupational health is not "limited to the prevention and control of work-related hazards, but should deal with the full relationship between work and health and include general health promotion" (WHO, 1988).

Occupational health nurses view health protection and health promotion in the workplace as positive constructs rather than negative ones. Consequently research into behaviors directed towards improving and maintaining the highest degree of health should be examined within a health-promoting context.

Limitations of the Study

The Health Belief Model, as used in this study, is a psychosocial model. Attempts to explain an individual's health-related behaviors are made solely on their attitudes and beliefs. In an effort to establish relationships with personal protective equipment use outside the realm of the Health Belief Model, other variables may also be considered. These include habitual behavior and environmental elements which may prevent a nurse from taking a "healthy" action, for example: working in a hazardous environment, such as being exposed to an antineoplastic drug spill in an elevator. The fact that in 11% of the spill clean-ups (n=5) nurses stated that they "were not in the habit of wearing the particular piece of equipment," requires further investigation outside of the Health Belief Model framework.

In this study, the definition of "antineoplastic drug administration" included both monitoring or discontinuing antineoplastic drug infusions, as well as giving the drugs. Therefore, those nurses who indicated that they had administered an antineoplastic drug became eligible to participate in the study whether or not they had been actually exposed or had the potential for exposure to antineoplastic drugs. It was not possible to be more specific regarding the nurses who only monitored drug infusions from the way in which the data was collected. One respondent reported, that while she only had a few weeks of experience in the institution after orientation she had monitored an intravenous infusion, although she had not administered or discontinued an antineoplastic drug. The inclusion of nurses who may have only monitored or discontinued infusions may have biased the results, compared with nurses who actually gave the drug. Without environmental monitoring capabilities and specific sensitive biological monitoring tests, differentiating actual drug exposure from potential exposure is unreliable and well beyond the scope of this investigation.

Perceived practices in relation to antineoplastic drug preparation and administration were based solely on the respondent's ability to recall and estimate the amount of drugs handled during the nurse's oncology career. No observations of the nurses compliance with personal protective equipment were made, nor were validation of exposures through patient charts recorded. Some items in the questionnaire dealt with recent practices and exposures, for example, almost all of the 124 nurse respondents had administered all four classifications of drugs with no statistically significant difference in frequency. There was, however, a significant difference between the recency of drug administration and the number of drugs given. It is probable that the nurse's memory recall was more precise for drugs given on the day of the interview, versus recall of several years ago. As a result, the practices reported by the respondents may not have completely reflected their actual practices, particularly in reporting those which occurred several years ago, compared with recent events.

The sample was asked whether or not supplemental training and certification was taken to qualify for the three-month "chemo-nurse" position. It was not until midway through the interview process that it became apparent that being certified did not necessarily translate into the nurse having occupied the position. It would have been more useful to have listed whether or not the position was ever occupied, regardless of certification.

This is the first time this questionnaire has been used in a study. There are no existing estimates of its validity and reliability in measuring the desired independent and dependent variables, other than the limited pre-test and the face and content validity.

Recommendations for Further Research

Questions arising out of present study data for further investigation:

In view of the fact that glove use is adopted more frequently than any other item of personal protective equipment, it would be relevant to explore with the nurse the ways in

which the use of gloves appears to occur more frequently than gowns, masks, or eyeglasses while preparing antineoplastic drugs or cleaning up antineoplastic drug spills. Such questions might include: Is it easier to use gloves versus other personal protective equipment? Would having the appropriate size of gloves or eyegoggles affect your utilization of personal protective equipment? Would having a spill kit containing all the recommended personal protective equipment in each infusion area affect your practice? If so, in what ways? Does the nurse perceive the practice of preparing and administering antineoplastic drugs as being different from any other type of drug? Does the nurse feel in control of her occupational exposures? Does she feel at risk, and if she does, at risk for what? How aware and concerned is she about her level of health?

Nurses receive a large amount of information in their educational programs about illness and its management, but little is given about health and its promotion as directly applied to self-health care behaviors (Boyd, 1988; Gordon, 1987). At different life stages, health-related behaviors may be perceived differently. Perhaps this perception imposes a contradiction in this sample of younger nurses, by directly affecting how they view themselves as health role models for patients, despite their poor reported health status. How nurses perceive themselves as health role models has become a focus of interest in current nursing research studies (Hoskin,1988) and is required within the oncology setting. These are just some of the areas that need to be explored, in order that further sources of motivation for personal protective equipment utilization can be identified rather than merely naming the variables and examining their relationships, as was done in this study.

Future studies should be conducted with a prospective design. Such studies should measure beliefs at a given point in time, and subsequent behavior, rather than attempting to measure both simultaneously as occurred in this retrospective investigation. To determine the effect of bias that may emanate from self-reported data, further studies are needed to

measure actual behavior over-and-above self-reported practices. It will also be essential to focus on the complex inter-relationships of the numerous factors that both influence the manner in which knowledge is received and the perceptions formed which influence healthy behaviors. A qualitative exploration in addition to the adaptation of a health-promoting behavioral model, such as Pender (1987, p.57) will enhance the ability of investigators within the oncology setting to develop a reliable body of knowledge on which intervention strategies can be designed to influence nurses' safe antineoplastic drug handling practices.

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Appendix A

Potential Health Hazards Associated with Occupational Exposure to Antineoplastic Drugs:

A Review of the Literature

POTENTIAL HEALTH HAZARDS ASSOCIATED WITH OCCUPATIONAL EXPOSURE TO ANTINEOPLASTIC DRUGS: A REVIEW OF THE LITERATURE

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POTENTIAL HEALTH HAZARDS ASSOCIATED WITH OCCUPATIONAL EXPOSURE TO ANTINEOPLASTIC DRUGS: A REVIEW OF THE LITERATURE

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Abstract

The field of oncology has made significant advances in the last quarter-century in the development of effective chemotherapeutic drugs against cancer. However, these advances have not been made without some risk to the patient. The observation of adverse biological changes in patients treated with anticancer drugs, has raised the question of antineoplastic drug preparation and administration as a source of mutagenic exposure to staff.

In light of the growing concern in handling these agents, several small studies have been carried out attempting to identify and measure the risk to health care personnel. Numerous institutional and organizational guidelines have been drawn up to minimize direct contact with antineoplastics during preparation and administration. Health care workers are not immune, and "sterile technique" cannot protect employees from inadvertently exposing themselves to potentially hazardous substances.

Awareness of the potential health hazards may have increased, based on the quantity of recently published literature, however, to what extent the knowledge of potential health risks has influenced practice is questionable. The provision of protective clothing and equipment does not guarantee compliance.

Guidelines that react to the current literature concerning potential health hazards have been based on non-specific methods that study occupational exposure to antineoplastic drugs eg. measuring urine mutagenicity and chromosomal abnormalities. The findings however, are insufficient and inconsistent. As a result, further research is needed to develop specific, efficient, and sensitive biological monitoring and medical surveillance regimes than the ones that are currently in use, in addition to enhancing the development of safer antineoplastic drug work practices.

POTENTIAL HEALTH HAZARDS ASSOCIATED WITH OCCUPATIONAL EXPOSURE TO ANTINEOPLASTIC DRUGS: A REVIEW OF THE LITERATURE

Background to the Problem

During the past three decades, as a result of treatment with antineoplastic drugs, there have been dramatic improvements in the survival of patients with cancer. This can be directly attributed to action taken from increased knowledge about the natural history of certain cancers, and the aggressive treatment with radiotherapy and chemotherapy. The basic objective of all cancer chemotherapy, is the preferential destruction of cancer cells, with sparing of normal cells as much as possible (Dreizen, Bodey, & Rodriquez, 1975). However, even in therapeutic dosages, cytotoxic drugs produce toxic side effects due to poor selectivity between target cells and normal cells (Rubadue, 1985).

Antineoplastic drugs or agents [also called cytotoxic drugs or agents] are toxic. Many have been shown to be mutagenic, and some have been identified by the International Agency for Research on Cancer [IARC] as having human carcinogenic potential (Vainio, Hemminki, & Wilbourn, 1985). The carcinogenic and genotoxic effects of cytotoxic drugs in experimental animals and man have raised concern as to the hazard posed to health care professionals involved in drug preparation or administration of these agents. Mutagenesis is closely related to carcinogenesis and directly related to genotoxicity and have major implications for further study (Chrysostomou, Morley, & Seshadri, 1984).

Classification of Antineoplastic Drugs

Antineoplastic drugs are designed to cause cell dysfunction by interacting with D.N.A., R.N.A., or protein synthesis in living cells, normal or cancerous (Vaughn & Christensen, 1985). Although antineoplastic drugs interfere with tumor cell growth, normal body cells are also at risk of attack and destruction. Antineoplastic drugs fall into four main categories. They are alkylating agents; mitotic inhibitors (vinca alkaloids); antimetabolites; and antitumor antibiotics (Sorsa, Hemminki, & Vainio, 1985). The

alkylating agents eg. nitrogen mustard derivatives, cyclophosphamide, and dacarbazine mainly act through alkylation damage on D.N.A. and other cellular nucleophiles. Mitotic Inhibitors eg. vincristine, vinblastine, and etoposide act on the mitotic apparatus necessary for mitosis [cell division]. The antimetabolites eg. fluorouracil and methotrexate are antagonists in the synthesis of folic acid, purines, pyrimidines or nucleotides; interfering with DNA synthesis by binding with these components. Antibiotics eg. adriamycin and bleomycin inhibit DNA transcription and duplication processes within the cellular genetic structure of both normal and neoplastic cells (Rogers, 1986; Sorsa et al.).

Occupational Exposure to Antineoplastic Drugs

In light of the growing concern in handling these agents, guidelines have been drawn up to minimize direct contact with these drugs during preparation and administration by institutions and organizations directly involved. [Guidelines are in use in Canada; the U.S.A.; Australia; Sweden; Norway and centers in the United Kingdom (Anderson et al., 1982; Hunt, 1984). Relatively simple precautions are recommended, for example, the preparation of cytotoxic drugs in central pharmacies under biosafety conditions; use of personal protective equipment eg. wearing long-sleeved gowns; latex surgical gloves; masks and eye protection during drug preparation, followed by thorough hand washing (Connor, Laidlaw, Theiss, Anderson, & Matney, 1984 ; Vaughn & Christensen, 1985; Yodaiken & Bennett, 1986). In addition, contaminated syringes, needles and containers should be carefully disposed of and personnel preparing and administering the agents should be monitored under a health surveillance program that provides for, protects and promotes the health and safety of those at risk (Chrysostomou et al., 1984; Stolar, Power, & Viele, 1983; University of Alberta Hospitals, 1985).

Routes of exposure to antineoplastic agents are primarily through inhalation of the aerosolized drug product; ingestion; and direct skin contact (Reich, 1981; Zimmerman, Larsen, Barkley, & Gallelli,1981). There are few reports of the occurrence of acute health effects among personnel handling antineoplastic drugs. Crudi (1980) reported non-specific

symptoms of headaches, dizziness, and nausea both personally and among co-workers during the reconstitution of antineoplastic drugs. Two co-workers reported nasal mucosal sores and hair loss that were attributed to the drugs, however no supporting biological or environmental data was documented. Nausea, vomiting, dizziness and headaches were also cited in anecdotal reports, from which it is impossible to establish any causal relationship (Hunt, 1984).

As potent chemicals, many of the drugs used have a direct irritant effect on the skin, eyes, mucous membranes and other tissues. Allergic and local reactions are reported, as well as, corneal ulcerations in the case of eye splashes. Sixteen out of twenty-five commercially available cytotoxic drugs induced skin irritation (Knowles & Virden, 1980). Cutaneous reactions resulting from direct contact with certain chemotherapeutic agents, like the alkylating agents are common (Gross, Johnson, & Bertino, 1981).

The Nature of Confounding Factors in Studying Occupational Exposure to Antineoplastic Agents

The topic of occupational exposure to antineoplastic agents is difficult to study because of the multitude of potentially hazardous substances that health care professionals are exposed to in a hospital. Waste anesthetic gases, ionizing radiation, sterilants, such as ethylene oxide and formaldehyde are only a few. Infectious disease exposures, physical hazards, and psychosocial problems confuse the study of a single component adversely affecting the health and well-being of workers (Babich, 1985; Crudi, Stephens, & Maier, 1982; Patterson et al., 1985).

The number of cytotoxic agents handled by health care professionals confounds the study of the health effects of any one agent, as these drugs are usually administered in combinations, not one at a time, and may be administered in conjunction with radiation and hormonal therapies (Hunt, 1984; Sorsa et al., 1985).

Another difficulty in the study of occupational exposure is the latency period between the first exposure to a carcinogen and the clinical appearance of a resulting cancer. A study

of personnel handling drugs could not be expected to detect any effect for a minimum of 5 years (for leukemia), and as long as 20 years or more (for lung cancer) (Stellman & Zoloth, 1986; Vainio, 1985). Consequently, even if a substantial risk for the development of cancer existed, it would be too soon to detect a result through epidemiologic study methodologies. Longitudinal studies are complicated by the fact that professionals handling antineoplastic drugs as a group are relatively small in number and mobile in occupational terms, making follow-up contact difficult.

Biologic Indicators of Exposure in Health Care Personnel

The effect of chronic occupational exposure to low levels of antineoplastic drugs has been attempted in health care personnel by biologically monitoring exposures. Specifically, exposure is determined through the measurement of urine mutagenicity, analytical methods, and the measurement of cytogenetic and reproductive effects (Sorsa, et al., 1985).

Urinary Mutagenicity

While it has been established that the urine of patients treated with alkylating antineoplastic drugs is mutagenic to bacteria, concern regarding the health of occupationally exposed personnel was initiated following the publication of a Finnish study reporting the elevated mutagenic urine levels in oncology nurses administering a combination of alkylating, vinca alkaloid, and antitumor antibiotic antineoplastic drugs. Falk et al. (1979) measured urinary mutagenicity by the bacterial fluctuation assay, and found that nurses had significantly higher levels than unexposed psychologist and office clerk control subjects. Only patients who had been treated with antineoplastic drugs had higher levels of urinary mutagenicity. The entire sample consisted of non-smokers, suggesting a correlation between occupational exposure to antineoplastic drugs and mutagenicity in urine. The sample size, as well as the frequency and recency of antineoplastic drug administrations were not reported.

Since the publication of the study by Falk et al. (1979), there has been a flurry of

investigations throughout the world yielding contradictory results utilizing bacterial assays, such as the Ames assay to measure urinary mutagenicity. The reported sample sizes of exposed oncology nurses, pharmacists and in some cases physicians studied have been small (range 2-59 subjects). Several investigators have found significant mutagenic urine levels in health care personnel handling antineoplastic agents compared with non-exposed controls (Benhamou et al., 1986; Bos, Leenaars, Theuws, & Henderson, 1982; Pohlova, Cerna, & Rossner, 1986; Rogers, 1984; Stucker, Hirsch, Doloy, Bastie-Sigeac, & Hemon, 1986; Venitt, Crofton-Sleigh, Hunt, Speechley, & Briggs, 1984).

Some investigators have identified the use of safety precautions as predictors for urine mutagenicity. Anderson et al. (1982) and Nguyen, Theiss and Matney (1982) collected 24-hour urine samples from six American pharmacists who prepared antineoplastic drugs over an eight-day period. Mutagenicity was reported during antineoplastic agent preparation in horizontal laminar flow hoods. However, when the pharmacists were gloved and prepared the agents in vertical laminar flow hoods, no urine mutagenicity was detected. Three non-exposed individuals chosen as control subjects did not report any urine mutagenicity. Similar findings were reported by Kolmodin-Hedman, Hartvig, Sorsa, and Falck (1983). In the case of this Swedish study, mutagenic activity was detected in the urine of hospital personnel who did not prepare antineoplastic drugs in a functional biological safety cabinet or reported inconsistent glove utilization.

An American study by Staiano, Gallelli, Adamson, and Thorgeirsson (1981) tested the urine of eight hospital pharmacists who mixed a combination of alkylating agents, vinca alkaloids, antimetabolites, and antitumor antibiotics in vertical laminar flow hoods. Urines were also obtained from persons outside the pharmacy department who mixed similar drugs in horizontal laminar flow hoods. No mutagenic activity was detected in the urine of any of the subjects. The literature contains other published studies with similar negative urine mutagenicity reports (Cloak et al., 1985 ; Connor, Theiss, Anderson, Puckett, & Matney, 1986; Hoffman, 1983; Sorsa, Pyy, Salomaa, Nylund, & Yager, 1988).

Confounding Factors Related to the Urinary Mutagenicity Assay

Nurses handling antineoplastic drugs may have their urine test positive for urine mutagens, however the nonspecificity of bacterial assays are further supported by studies detecting urinary mutagen excretion unrelated to occupational drug exposures. The link originally proposed between urinary mutagenicity and occupational exposure to antineoplastic drugs could be less valid than originally suggested because smoking, alcohol, diet (cured meat products) and medication intake (metronidazole; nitrofurantoin) can cause or contribute to urinary mutagenicity (Baker, Arlauskas, Bonin, & Angus, 1982; Bos et al., 1982; Connor, Stoeckel, Evrard, & Legator, 1977; Everson, Ratcliffe, Flack, Hoffman, & Watanabe, 1985; Wang, Benson, & Bryan, 1977; Yamasaki & Ames, 1977). Due to the lack of specificity and the potential effects of environmental and dietary factors on urine results, bacterial mutagenicity tests should not be solely and routinely used for detecting accidental absorption of antineoplastic drugs (Tuffnell, Gannon, Dong, DeBoer, & Erlichman, 1986).

Urinary Analytical Methods: (determines antineoplastic agent exposure in biological samples)

Two research studies, one in London, England and the second at the University of Western Ontario, Canada reported evidence of human absorption from antineoplastic drug handling exposure. Jagun, Ryan, and Waldron (1982) measured the levels of thioethers in the urine of nurses who handled cytotoxic drugs. (Thioethers are products of metabolism of alkylating agents, and are used as a laboratory screening technique to indicate exposure with the alkylating group of antineoplastic drugs). The study cited that 12 of the 15 nurses wore gloves during handling. No other protective precautions were used. The findings suggested that the nurses who regularly worked with the drugs seemed to absorb sufficient amounts of the drug either through aerosolized droplet inhalation or through the skin, to significantly raise the urinary excretion of thioethers.

The second study collected urine samples from two oncology nurses handling

cyclophosphamide (an alkylating agent), and five volunteers who had the drug topically applied to their arm for six hours and then washed off thoroughly with soap and water. (The volunteers were previous cancer patients in remission, and were not currently receiving a chemotherapy regime). The nurses' urine samples contained quantifiable amounts of cyclophosphamide, and 4 of the 5 volunteers had the drug in their urine 6 hours post-application. The authors of the study concluded that cyclophosphamide can be absorbed through intact human skin (positive findings in volunteers). As well, the rapid excretion found in the nurses suggests that the drug was inhaled during preparation, possibly from aerosolized droplets released from the drug vial, signalling the importance of protective measures while preparing and administering antineoplastic drugs (Hirst, Tse, Mills, & Levin, 1984).

Biological Monitoring of Cytogenetic Effects

As a consequence of antineoplastic drugs' ability to damage chromosomes, the surveillance of chromosomal damage in human somatic cells has been used as a biological monitoring method for genotoxic exposure (Sorsa et al., 1985). Antineoplastic drugs, mainly the alkylating agents have been shown to induce chromosomal changes in peripheral blood lymphocytes and sister chromatid exchanges (SCE) in workers engaged in the synthesis and preparation of newly developed drugs (Pohlova, Cerna, & Rossner, 1986). A group of eleven Finnish oncology nurses had a higher frequency of chromosomally aberrant lymphocytes, than was found in their non-exposed control group [laboratory workers and hospital clerks]. Correlations between age and structural chromosome aberrations, as well as, age and the retention of chromosome damage caused by mutagens was reported, suggesting that the increase in chromosomal aberrations may have been due to the lengthy number of years that the nurses worked with antineoplastic drugs (Nikula, Kiviniitty, Leisti, & Taskinen, 1984). Increased chromosomal abnormalities in lymphocytes were reported in nurses handling antineoplastic drugs on a daily basis (Norppa et al., 1980; Waksvik, Klepp, & Brogger, 1981).

An opposing study of 17 oncology nurses concluded that moderate exposure to antineoplastic drugs eg. administering 11 infusions per week, did not cause detectable cytogenetic abnormalities even though urine mutagenicity was significantly increased (Stucker, Hirsch, Doloy, Bastie-Sigeac, & Hemon, 1986). Negative results for sister-chromatid exchange in lymphocytes of 47 nurses and pharmacists occupationally exposed to cyclophosphamide (an alkylating agent) was reported in a Finnish study (Sorsa, Pyy, Salomaa, Nylund, Yager, 1988). No chromosomal abnormalities were found in either of the following two studies. The first consisting of 13 German hospital workers handling cytostatic drugs (Stiller, Obe, Boll, & Pribilla, 1983). The second, a study of 18 American oncology nurses handling antineoplastic drugs an average of three days per week (Jordan, Patil, Jochimsen, Lachenbruch, & Corder, 1986).

A report from Finland documented liver damage in three head oncology nurses after six to sixteen years of handling cytotoxic drugs. The authors concluded that the handling of cytostatic drugs may insidiously damage the liver, which with time seems to lead to irreversible fibrosis (Sotaniemi et al., 1983).

Although measuring clastogenic changes in lymphocytes has currently been the most applied technique for biologically monitoring genotoxic chemicals in workers, chromosome analyses have not been sensitive enough to detect cytogenetic effects in workers at low levels of exposure (de Jong, van Sittert, & Natarajan, 1988). Chromosomal analysis as a sole measure of human exposure to antineoplastic drugs is not reliable. Reports of cytogenetic changes remain contradictory, and have been found to have significant results in studies of occupational exposure to agents other than antineoplastic drugs (Jordan, et al., 1986). Further research is needed in the area to develop more specific, efficient and sensitive biological monitoring regimes than the ones that are currently in use.

Occupational Exposure to Antineoplastics and its Effects on Human Reproduction

The preponderance of literature, with respect to the adverse effects of antineoplastic agent exposure on reproduction in handlers is inconclusive. Reproductive impairment is

estimated to affect 30% of American couples, however, the proportion of cases directly attributable to occupational exposures remains unknown (Rosenberg, Feldblum, & Marshall, 1987). Studies regarding the potential abortive and teratogenetic effects of chemotherapeutic agents have cautioned health care workers about such possibilities during the first trimester of pregnancy eg. embryos and fetuses have a large number of growing cells and are especially susceptible to the toxic effects of cytotoxic agents [which disrupt cell growth and kill actively growing cells] (Sorsa et al., 1985).

The most stringent precautions have arisen from Norway [Directorate of Labor Inspection]. Specifically pregnant and breast-feeding women are advised not to handle antineoplastic agents. In addition, other high-risk individuals are listed and include those who anticipate pregnancies, have allergies or congenital malformations, have had previous abortions or cancer treatment, and those who work with ionizing radiation (Anderson, et al., 1982).

In a Finnish case-control study of 124 nurses experiencing fetal loss associated with handling antineoplastic drugs during their pregnancy, it was found that nurses who experienced a fetal loss were 2.3 times as likely to have had a first trimester exposure to antineoplastic drugs, as compared with non-exposed nurses from similar hospitals in Finland who also gave birth [control group] (Selevan, Lindbohm, Hornung, & Hemminki, 1985). The study leads one to suggest that such an association is cause for concern. Further studies are needed, not only to investigate spontaneous abortions but other potential health impairments such as infertility and long-term health risks of malignancy.

Discussion on Causality

The literature on antineoplastic agents has suggested an association between antineoplastic handling and side effects, but there is insufficient evidence to determine that cytotoxic drug handling or mixing causes cancer (Rubadue, 1985). No studies are as yet available on the possible carcinogenic effects of occupational handling of anticancer drugs. [The only substantiated evidence exists in oncological patient studies] (Sorsa et al., 1985).

Precautions to minimize direct contact with antineoplastic drugs seem to be successful in eliminating observable urine mutagenicity and complaints of side effects, however, there are no longitudinal studies that investigate the long-term health effects of handling antineoplastic agents (Crudi et al., 1982; Hunt, 1984). Few studies have been conducted with health care workers. Laboratory animal studies and epidemiological data from patients treated with cytotoxic agents exist, but none of these studies truly parallels the antineoplastic drug exposure undergone by health care professionals (Crudi et al.; Hunt).

Implications for Future Research

The literature regarding the safe handling of antineoplastic drugs suggests that there is often a failure on the part of health personnel to recognize that low-level exposures may pose a substantial risk. Health care workers are not immune, and 'sterile technique' cannot protect workers from hazards associated with the handling of antineoplastic drugs (Bingham, 1985). A change in this perception was recently voiced by the American National Study Commission on Cytotoxic Exposure, as it disbanded. The commission believes that awareness of the issues involved in handling cytotoxic drugs has grown dramatically, it urged health professionals to continue interdisciplinary efforts to study certain unresolved issues. These included the creation of an exposure registry and epidemiological studies to assess the actual degree of risk. As well, practical methods of monitoring occupational exposure were some of its recommendations that should be undertaken (Gallina, 1988).

Conclusion

An increasing number of patients are receiving antineoplastic agents for the treatment of cancer, involving more health professionals, particularly nurses and pharmacists in the handling and administering of antineoplastic drugs. Historically, the main concern of nurses and pharmacists was to preserve the sterility and integrity of the drugs being prepared and administered to patients, without the regard to the health risks of exposure (Vaughn & Christensen, 1985). Evidence of occupational exposure albeit conflicting, is

apparent through biological monitoring tests. In view of the fact that carcinogenicity, mutagenicity and teratogenicity have been established in animal studies, and carcinogenicity and teratogenicity of pharmacologic doses of some cytotoxic agents in humans, what is not known is the risk, if any, of chronic low level exposures to health care workers. Studies on the long-term health effects to workers who prepare or administer cytotoxic drugs remain inconclusive (Hunt, 1984; Miller, 1987).

The potential risks to nurses, physicians and pharmacists from repeated contact with antineoplastic drugs can best be reduced by engineering controls, employee education and adherence to safe work practices. Reduction in the health care workers' exposure to antineoplastic drugs is the most important preventive measure (Stellman & Zoloth, 1986).

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Appendix B

Oncology Nurses' Perceptions Questionnaire

ONCOLOGY NURSES' PERCEPTIONS QUESTIONNAIRE

The questionnaire is divided into the following sections:

Section A

Reported Practices Regarding Antineoplastic Drug Exposures:

1. Current Occupational Exposure or History of Past Exposure to Antineoplastic Agents
2. Frequency and Characteristics of Handling Antineoplastic Agents including personal protective equipment utilization
3. Oncology Nurse Perceptions - Perceived Barriers (subjective perceptions regarding the negative aspects of wearing personal protective equipment)
4. Training, Learning Resource Utilization and Knowledge of Safe Antineoplastic Drug Handling Practices

Section B

Nurses Reported Health Status; Exposure to Associated Hospital Occupational Hazards:

1. Knowledge of Associated Health Care Occupational Exposures
2. Reported Practices

Section C

Oncology Nurses' Perceptions:

1. Personal Susceptibility (possessing a subjective perception of risk for having health affected by antineoplastic drug handling)
    i. Risk expressed in 3rd Person
    ii. Personal Risk
2. Perceived Severity (subjective perceptions regarding the seriousness of contracting potential health effects associated with antineoplastic drug exposures)
3. Modifying Factors- degree of co-worker influence on respondents to use personal protective equipment

Section D

Demographic Information

ONCOLOGY NURSES' PERCEPTIONS OF OCCUPATIONAL EXPOSURE TO ANTINEOPLASTIC DRUGS

SECTION A

The first set of questions that I would like to ask you, deal with the preparation and administration of antineoplastic drugs. By preparation, I mean the mixing or reconstitution of the drug. By administration, I mean giving the drug monitoring the infusion of the drug or discontinuing the intravenous, intra-arterial, intraperitoneal, intra-tumor, intrathecal, or bladder instillation equipment. By antineoplastic drugs, I mean those chemotherapeutic drugs which are used to inhibit the growth of malignant cells. (Show respondent booklet pg. 1)

1. Do you or do you not currently prepare or administer antineoplastic drugs in your work here?
   1--YES 0--NO (Turn to box *** pg 4 and tick appropriate box) — A1_____

   (If NO) In the past, have you prepared or administered antineoplastic drugs here or in any other health care agency?

   1--YES 0--NO ⟶ (If NO, terminate interview) — A1b_____

   What was the last year that you prepared or administered antineoplastic drugs in your job?
   YEAR _____ — A1c_____

2. In what year did you first start preparing or administering antineoplastic drugs?
   YEAR_____ (Turn to box ***-pg 2 and record answer) — A2_____

Now I would like to ask you some questions about antineoplastic drugs, regardless of whether or not you are currently working with these drugs.

3. What would you do if some antineoplastic drugs came in contact with your skin?

   4--NOTHING
   3--WIPE WITH A PAPER TOWEL
   2--RINSE WITH WATER
   1--WASH WITH SOAP AND WATER
   0--OTHER, SPECIFY _____ — A3_____

4. Where would you discard waste antineoplastic drugs or syringes, vials, administration sets used in the preparation or administration of antineoplastic agents?
1--designated cytotoxic waste containers 0--regular garbage cans A4_____

Next I would like to ask you some questions specifically about preparing antineoplastic drugs.
(Show respondent booklet pg. 2):

5. Have you or have you not ever prepared any antineoplastic drugs?
1--YES 0--NO 2--NOT SURE A5_____
↓ ↓ ↓
(If YES) (GO TO QUESTION # 8)
When was the last time that you prepared an antineoplastic drug?
_____ (If preparation was within the last year, show respondent booklet pg. 3 and ask): A5b_____
Of the dosages that you prepared in the last year, how often did you wear:
EYEGLASSES?
4--ALWAYS 3--FREQUENTLY 2--ABOUT HALF OF THE TIME
1--OCCASIONALLY 0--NEVER A5c_____
A MASK?
4--ALWAYS 3--FREQUENTLY 2--ABOUT HALF OF THE TIME
1--OCCASIONALLY 0--NEVER A5d_____
A CLOSED-FRONT LONG SLEEVED GOWN?
4--ALWAYS 3--FREQUENTLY 2--ABOUT HALF OF THE TIME
1--OCCASIONALLY 0--NEVER A5e_____
GLOVES?
4--ALWAYS 3--FREQUENTLY 2--ABOUT HALF OF THE TIME
1--OCCASIONALLY 0--NEVER A5f_____

*** ☐- started working with antineoplastic drugs prior to and including 1983.
☐- started working with antineoplastic drugs after 1983 ——→(GO TO QUESTION # 8)

I just want to confirm that you were working with antineoplastic drugs prior to, and including 1983.
Is that correct?
☐YES ☐NO
(GO TO QUESTION #8)

These next few questions concern the preparation of antineoplastic drugs prior to and including 1983.

6. Did you prepare these drugs in the general medication room, some other area, or both?
   1--GENERAL MEDICATION ROOM 0--OTHER, SPECIFY_____ 2-- BOTH A6_____

7. In preparing these drugs, was it your practice to wear any of the following? (Show respondent booklet pg. 4):

EYEGLASSES	A MASK	A CLOSED-FRONT LONG SLEEVED GOWN	GLOVES	
1--YES 0--NO	1--YES 0--NO	1--YES 0--NO	1--YES 0--NO	A7____

   0000-- NONE OF THE ABOVE

   Were there any other things that you did while preparing antineoplastic drugs that I have not mentioned here?
   1--YES, SPECIFY_____
   0--NO A7b_____

The next group of questions deal with your specific involvement in the administration of antineoplastic drugs during your entire nursing career. (Show respondent booklet pg. 5). I am going to show you four lists with the names of antineoplastic drugs on them.
(Show respondent booklet pg. 6- ALKYLATING AGENTS):

8. I want you to look at this list and tell me if you have ever administered any of the drugs on this list?
   1--YES 0--NO 2--NOT SURE A8_____
   ↓
   (IF YES) When was the last time that you administered one of these drugs?
   _____ A8b_____
   How frequently in an average week would you say that you administered one of these drugs?
   _____ A8c_____

(Show respondent booklet pg. 7 -VINCA ALKALOIDS- Mitotic inhibitors):

9. I want you to look at this list and tell me if you have ever administered any of the drugs on this list?
   1--YES 0--NO 2--NOT SURE A9_____
   ↓
   (IF YES) When was the last time that you administered one of these drugs?
   _____ A9b_____
   How frequently in an average week would you say that you administered one of these drugs?
   _____ A9c_____

(Show respondent booklet pg. 8--ANTIMETABOLITES):

10. I want you to look at this list and tell me if you have ever administered any of the drugs on this list?
    1--YES 0--NO 2--NOT SURE A10_____

    (IF YES) When was the last time that you administered one of these drugs?

    _____ A10b_____

    How frequently in an average week would you say that you administered one of these drugs?

    _____ A10c_____

(Show respondent booklet pg. 9- ANTITUMOR ANTIBIOTICS):

11. I want you to look at this list and tell me if you have ever administered any of the drugs on this list?
    1--YES 0--NO 2--NOT SURE A11_____

    (IF YES) When was the last time that you administered one of these drugs?

    _____ A11b_____

    How frequently in an average week would you say that you administered one of these drugs?

    _____ A11c_____

*** ☐- currently working with antineoplastic drugs
    ☐- not currently working with antineoplastic drugs ——>(GO TO QUESTION # 15)

12. In your work last week, how many antineoplastic drug dosages did you administer?

    _____ A12_____

13. Of these dosages, how many times did you wear gloves?

    _____ A13_____

    [If not "always" ask]:
    What kinds of things kept you
    from wearing gloves some of the time?

    _____ A13b_____

14. Have you had to clean up any antineoplastic drug spills during the last year?

1--YES 0--NO A14_____

(If NO, GO TO QUESTION # 15)

Approximately how many?

_____ A14b_____

Of these clean-ups, how many times would you have worn:

EYEGLASSES?_____ [If not "always" ask]: What kinds of things kept you from wearing eyeglasses some of the time? _____ A14c_____ A14'_____

A MASK?_____ [If not "always" ask]: What kinds of things kept you from wearing a mask some of the time? _____ A14e_____ A14f_____

A CLOSED-FRONT LONG SLEEVE GOWN?_____ [If not "always" ask]: What kinds of things kept you from wearing a closed-front long sleeve gown some of the time? _____ A14g_____ A14h_____

GLOVES?_____ [If not "always" ask]: What kinds of things kept you from wearing gloves some of the time? _____ A14i_____ A14j_____

15. Some people have accidently spilt antineoplastic drugs onto their skin.
Have you ever had any antineoplastic drugs on your skin?

1--YES 0--NO 2--NOT SURE A15_____

16. Some people have had antineoplastic drugs accidently go into their eyes.
Have you ever had this happen to you?

1--YES 0--NO 2--NOT SURE A16_____

Next, I would like to ask you a few questions about the training you have had regarding antineoplastic drugs.

17. Have you, or have you not had any training in:
the preparation of antineoplastic drugs?

1--YES 0--NO 2--NOT SURE A17_____

the administration of antineoplastic drugs to patients?

1--YES 0--NO 2--NOT SURE A17b_____

the disposal of antineoplastic waste materials?

1--YES 0--NO 2--NOT SURE A17c_____

the use of personal protective equipment, such as gloves; gown; mask; eyeglasses?

1--YES 0--NO 2--NOT SURE A17d_____

skin contact and spill clean-up procedures?

1--YES 0--NO 2--NOT SURE A17e_____

health effects to health personnel from exposure to antineoplastic agents?

1--YES 0--NO 2--NOT SURE A17f_____

18. Have you, or have you not had the opportunity to take [or make use of]:

"the advanced chemotherapy teaching program"?

1--YES 0--NO A18_____

in-service training on antineoplastic drugs?

1--YES 0--NO A18b_____

seminars / conferences on antineoplastic drugs?

1--YES 0--NO A18c_____

professional journal articles on antineoplastic drugs?

1--YES 0--NO A18d_____

19. Does your hospital have guidelines for nurses about the preperation and administration of antineoplastic drugs?

1--YES 0--NO 2--UNKNOWN A19_____

(Skip to Question #22)

20. How well would you say that you know the guidelines? (Show respondent booklet pg. 10):

1 2 3 4 5 6 7

Not At All Very Well A20_____

21. Do these guidelines meet your needs or do they not meet your needs?

1--YES 2--MOST OF THE TIME 0--NO A21_____

(If NOT COMPLETELY, where do you see the gaps)? _____

_____ A21b_____

SECTION B

Now I would like to ask you some questions about your general health and work.

22. How would you describe your general health on this scale? (Show respondent booklet pg. 11)

1	2	3	4	5	6	7
Poor Health Barely Able to Work						Excellent Health- No Trouble Working

B22_____

23. Do you or do you not wear glasses at work?

1--YES 0--NO

B23_____

The next few questions cover your entire career in nursing.

24 Ionizing radiation is associated with x-ray therapy or nuclear medicine procedures. While working in a health care setting, have you or have you not been exposed to ionizing radiation?

1--YES 0--NO 2--NOT SURE

B24_____

(If YES) Was it or was it not your practice to wear protective equipment such as a leaded apron while working with ionizing radiation?

1--YES 0--NO 2--NOT SURE

B24b_____

25. Anesthetic gases can be found in operating rooms, and sometimes in other locations. While working in a health care setting, have you or have you not been exposed to anesthetic gases?

1--YES 0--NO 2--NOT SURE

B25_____

(If YES) Were control measures in place for ventilating the waste gases out of the area or were they not in place?

1--YES 0--NO 2--NOT SURE

B25b_____

26 Chemicals, such as sterilizing agents and solvents are used in many health care locations. While working in a health care setting, have you or have you not been exposed to chemical agents?

1--YES 0--NO 2--NOT SURE

B26_____

(If YES) Was it or was it not your practice to wear protective equipment such as gloves while working with these chemical agents?

1--YES 0--NO 2--NOT SURE

B26b_____

27. Now specifically concerning your reproductive health, would you or would you not consider yourself as being infertile?

1--YES 0--NO 2--DON'T KNOW B27_____

SECTION C

Now for some questions about your beliefs regarding antineoplastic drugs.

28. To what extent do your co-workers encourage you, discourage you, or have no influence in your decision to wear personal protective equipment like gloves while administering antineoplastic drugs? (Show respondent booklet pg. 12):

4--NONE AT ALL 3--A LITTLE 2--A MODERATE AMOUNT 1--QUITE A BIT 0--A GREAT DEAL C28_____

29. How often do other people you work with wear personal protective equipment like gloves while administering antineoplastic drugs? (Show respondent booklet pg. 13):

4--ALWAYS 3--FREQUENTLY 2--ABOUT HALF OF THE TIME 1--OCCASIONALLY 0--NEVER C29_____

30. If a nurse does not wear gloves while preparing or administering antineoplastic drugs, how likely is it that some health problem will result? (Show respondent booklet pg. 14):

5--VERY LIKELY
4--QUITE LIKELY
3--SOMEWHAT LIKELY
2--NOT TOO LIKELY
1--NOT AT ALL LIKELY C30_____

(Show respondent booklet - pg # 15)	a. From preparing or administering antineoplastic drugs, how likely would it be, for you to have [get] _____?								b. How serious would [this] _____ be for you? (Show respondent booklet pg # 16)						
	VERY LIKELY							NOT AT ALL LIKELY	EXTREMELY SERIOUS						NOT AT ALL SERIOUS
31. AN INCREASED SUSCEPTIBILITY TO ILLNESS 31a_____ 31b_____	7	6	5	4	/3	2	1	(Go to Ques. # 32)	7	6	5	4	3	2	1
32. A SKIN RASH 32a_____ 32b_____	7	6	5	4	/3	2	1	(Go to Ques. # 33)	7	6	5	4	3	2	1
33. DIZZINESS 33a_____ 33b_____	7	6	5	4	/3	2	1	(Go to Ques. # 34)	7	6	5	4	3	2	1
34. IRRITABILITY 34a_____ 34b_____	7	6	5	4	/3	2	1	(Go to Ques. # 35)	7	6	5	4	3	2	1
35. AN EYE INFECTION 35a_____ 35b_____	7	6	5	4	/3	2	1	(Go to Ques. # 36)	7	6	5	4	3	2	1
36. A MISCARRIAGE 36a_____ 36b_____	7	6	5	4	/3	2	1	(Go to Ques. # 37)	7	6	5	4	3	2	1
37. CANCER 37a_____ 37b_____	7	6	5	4	/3	2	1	(Go to Ques. # 38)	7	6	5	4	3	2	1

Section D

Just a few more questions.

38. What year did you graduate from your basic nursing program, (year in which R.N. was obtained)?
_____ D38_____

39. Since that time, how many years of nursing experience have you had (after completion of your basic education program)?
_____ D39_____

40. Of these years, how many have you spent nursing in an oncology setting?
_____ D40_____

41. What is your current job in nursing? (Show respondent booklet pg. 17):
4--Staff nurse giving direct patient care
3--Nursing administration (head nurse or equivalent and up)
2--Nursing education (in-service educator; clinical instructor or professor)
1--Nurse in Clinical Research
0--Other, specify _____ D41_____

42. What department are you employed in? (Show respondent booklet pg. 18):
7--Inpatient Oncology Ward 6--Out- Patient Clinic 5--Operating Room / Recovery Room
4--Radiation Therapy 3--Education 2--Administration 1--Clinical Research
0--Other, specify _____ D42_____

43. Do you currently work full-time, part-time, or another schedule, in nursing?
2--Full-time 1--Part-time 0--Other, specify_____ D43_____

44. What is the highest level of education that you have completed? (Show respondent booklet pg. 19):
4--Diploma in Nursing - R.N. 3--Post R.N. Certificate or Diploma 2--Baccalaureate Degree
1--Masters Degree 0--Doctoral Degree D44_____

45. What is your date of birth?
☐☐ ☐☐ ☐☐
MONTH DAY YEAR D45_____

46. Sex 1--Female 0--Male (Checked off by researcher upon observation during the interview) | D46_____

We are now at the end of the questionnaire, and I would really like to thank you for your participation. As I am finished asking you questions, is there anything you would like to ask me?

Appendix C

Respondent Booklet Accompanying

Oncology Nurses' Perceptions Questionnaire

Respondent Booklet- Page 1- Definitions of Preparation, Administration and Antineoplastic Drugs as stated in the introductory paragraph of the Oncology Nurses' Perceptions Questionnaire

PREPARATION OF ANTINEOPLASTIC DRUGS

In this study, means the mixing or reconstitution of the drug.

ADMINISTRATION OF ANTINEOPLASTIC DRUGS

In this study, means giving the drug, monitoring the infusion of the drug, or discontinuing the intravenous, intra-arterial, intraperitoneal, intratumor, intrathecal, or bladder instillation equipment.

ANTINEOPLASTIC DRUGS

In this study, means those chemotherapeutic drugs which are used to inhibit the growth of malignant cells.

Respondent Booklet- Page 2- Definition of the Preparation of Antineoplastic Drugs

PREPARATION OF ANTINEOPLASTIC DRUGS

In this study, means the mixing or reconstitution of the drug.

Respondent Booklet- Page 3- Responses to Questions A5c-A5f:

Of the dosages that you prepared in the last year, how often did you wear: eyeglasses? a mask? a closed-front long sleeved gown? gloves?

ALWAYS

FREQUENTLY

ABOUT HALF OF THE TIME

OCCASIONALLY

NEVER

Respondent Booklet- Page 4- Responses to Question A7:

In preparing these drugs, was it your practice to wear any of the following?:

EYEGLASSES

A MASK

A CLOSED-FRONT LONG SLEEVED GOWN

GLOVES

NONE OF THE ABOVE

Respondent Booklet- Page 5- Definition of the Administration of Antineoplastic Drugs

ADMINISTRATION OF ANTINEOPLASTIC DRUGS

In this study, means giving the drug, monitoring the infusion of the drug, or discontinuing the intravenous, intra-arterial, intraperitoneal, intratumor, intrathecal, or bladder instillation equipment.

Respondent Booklet- Page 6- Examples of Alkylating Agents

ALKYLATING AGENTS

mechlorethamine (Nitrogen Mustard)
cyclophosphamide (cytoxan)
dacarbazine (DTIC)
cisplatin (platinol)
carmustine (BCNU)
semustine
thiotepa
streptozocin (Zanosar)
busulfan (Myleran)
chlorambucil
procarbazine (Matulane)
melphalan

Respondent Booklet- Page 7- Examples of Vinca Alkaloids
(Mitotic Inhibitors)

VINCA ALKALOIDS- Mitotic Inhibitors

vincristine (VCR; Oncovin)
vinblastine (Velbe; Velban)
vindesine (DAVA)
etoposide (VE- 16-213; Vepesid)
teniposide (VM-26)

Respondent Booklet- Page 8- Examples of Antimetabolites

ANTIMETABOLITES

fluorouracil (5-FU; Adrucil)
cytarabine (ARA-C; Cytosar)
methotrexate (Mexate; Folex; MTX)
azathioprime
mercaptopurine
thioguanine
azacytidine (5-AC)

Respondent Booklet- Page 9- Examples of Antitumor Antibiotics

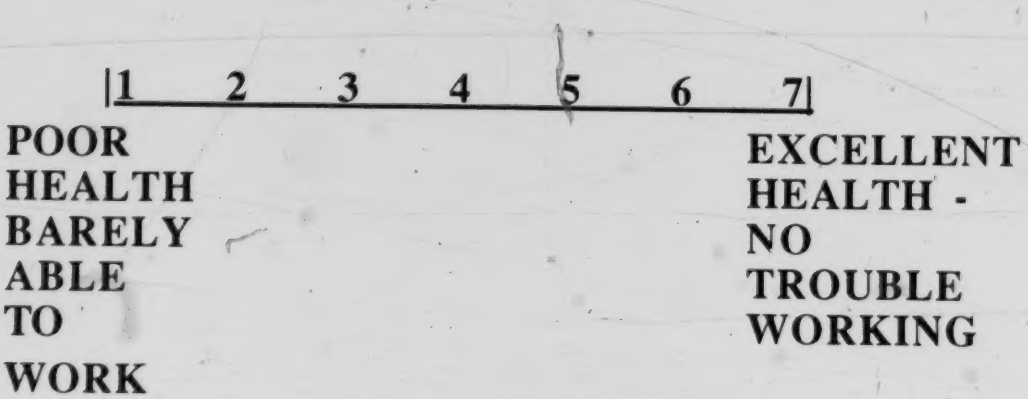
ANTITUMOR ANTIBIOTICS

doxorubicin (Adriamycin)
bleomycin ("Bleo"; Blenoxane)
dactinomycin (Actinomycin-D; Cosmegen)
mitomycin (Mutamycin)
mitoxantrone (Novantrone)
daunorubicin (Daunomycin)

Respondent Booklet- Page 10- Scale for Question A20: How well would you say that you know the guidelines?

1	2	3	4	5	6	7
NOT AT ALL						VERY WELL

Respondent Booklet- Page 11- Scale for Question B22: How would you describe your general health on this scale?



Respondent Booklet- Page 12- Responses to Question C28:

To what extent do your co-workers encourage you, discourage you, or have no influence in your decision to wear personal protective equipment like gloves while administering antineoplastic drugs?

NONE AT ALL

A LITTLE

A MODERATE AMOUNT

QUITE A BIT

A GREAT DEAL

Respondent Booklet- Page 13- Responses to Question C29:
How often do other people you work with wear personal protective equipment like gloves while administering antineoplastic drugs?

ALWAYS

FREQUENTLY

ABOUT HALF OF THE TIME

OCCASIONALLY

NEVER

Respondent Booklet- Page 14- Responses to Question C30:

If a nurse does not wear gloves while preparing or administering antineoplastic drugs, how likely is it that some health problem will result?

VERY LIKELY

QUITE LIKELY

SOMEWHAT LIKELY

NOT TOO LIKELY

NOT AT ALL LIKELY

Respondent Booklet- Page 15- Scale for Questions C31a-37a:

From preparing or administering antineoplastic drugs, how likely would it be, for you to have [get] an increased susceptibility to illness; a skin rash; dizziness; irritability; an eye infection; a miscarriage; cancer?

1	2	3	4	5	6	7
NOT AT ALL LIKELY						VERY LIKELY

Respondent Booklet- Page 16- Scale for Questions C31b-37b:

How serious would [this] increased susceptibility to illness; a skin rash; dizziness; irritability; an eye infection; a miscarriage; cancer be <u>for you</u>?

1	2	3	4	5	6	7
NOT AT ALL SERIOUS						**EXTREMELY SERIOUS**

Respondent Booklet- Page 17- Responses to Question D41:

What is your current job in nursing?

STAFF NURSE GIVING DIRECT PATIENT CARE

NURSING ADMINISTRATION (Head Nurse or equivalent and up)

NURSING EDUCATION (In-Service Educator; Clinical Instructor or Professor)

NURSE IN CLINICAL RESEARCH

OTHER, Specify _____

Respondent Booklet- Page 18- Responses to Question D42:

What department are you employed in?

INPATIENT ONCOLOGY WARD

OUT-PATIENT CLINIC

OPERATING ROOM / RECOVERY ROOM

RADIATION THERAPY

EDUCATION

ADMINISTRATION

CLINICAL RESEARCH

OTHER, Specify _____

Respondent Booklet- Page 19- Responses to Question D44:

What is the highest level of education that you have completed?

DIPLOMA IN NURSING - R. N.

POST R. N. CERTIFICATE OR DIPLOMA

BACCALAUREATE DEGREE

MASTERS DEGREE

DOCTORAL DEGREE

Appendix D

Introductory Letter to Potential Respondents

ARE YOU A REGISTERED NURSE WORKING WITH ANTINEOPLASTIC DRUGS ?

If you answered yes to this question, I would like to speak with you.

My name is Peggy Szumlas and I am a graduate student in the Master's of Nursing Program, University of Alberta. I am conducting a thesis study regarding the perceptions oncology nurses have about handling antineoplastic drugs. I would therefore, like to talk to registered nurses that have worked with antineoplastic drugs, during preparation, administration or both. I want to learn from you what types of antineoplastic drugs you have worked with, whether and how often you have mixed or administered these drugs, how you have handled them, and how you feel about working with antineoplastic drugs. Even if you have worked with antineoplastic drugs in the past, but are no longer working with them, I would really like to talk to you.

If you agree to participate, a personal and private interview will be held with you on your ward, at a convenient time according to patient care requirements during your shift, using a designated conference room. The interviews will be scheduled to start the end of May, and will take approximately twenty minutes. All answers will be kept confidential, and your name will not be required on the questionnaire that will be discussed in the interview. Your individual answers will not be forwarded to your employer, and a general summary will be made available to you through your librarian after the conclusion of the study.

Your participation and expertise in oncology nursing will be extremely valuable in determining the results of this study. Your involvement is significant, and will be most appreciated. I will contact you on your nursing unit. See you soon!

Sincerely

Peggy Szumlas R.N.,B.N.,O.H.N.C.

Appendix E

Respondent Information Sheet

INFORMATION SHEET

STUDY: Oncology Nurses' Perceptions of Occupational Exposure to Antineoplastic Drugs

Researcher: Peggy Szumlas
Master of Nursing Student
Faculty of Graduate Studies &
Research- Faculty of Nursing
University of Alberta
Telephone: 432-6251

Supervisor: Dr. J. Lander
Faculty of Nursing
University of Alberta
Telephone: 432-6317

The purpose of this study is to survey oncology nurses to determine their practices, knowledge, and perceptions regarding antineoplastic drug preparation and administration.

1. Your name is not required, and the information that you give me will be kept confidential. Your individual answers will not be forwarded to your employer, and because your name is not needed, it will not appear on any research reports.

2. You may refuse to be interviewed, or to answer any questions you do not wish to answer. You may also terminate the interview or withdraw from the study without fear of retribution.

3. The private interview survey will take approximately 20 minutes, during which time you will be asked questions related to your handling of antineoplastic drugs.

4. A general summary will be made available to your librarian after the conclusion of the study (anticipated date- October, 1988). The summary will describe characteristics of the entire study group, thus preventing the identification of any individual.

Do you have any questions for me?

_____ _____

Researcher's Signature Date

Appendix F

Letter of Permission for Institutional Guidelines

ALBERTA CANCER BOARD

CROSS CANCER INSTITUTE
NORTHERN ALBERTA CANCER PROGRAM

May 20, 1988

Ms. Peggy Szumlas
Master of Nursing Student
Faculty of Graduate Studies
Department of Nursing
University of Alberta
Edmonton, Alberta

Dear Ms. Szumlas:

Following our numerous meetings, and in discussion with the Director of Nursing, Ms. Mary James, permission is hereby granted to you to quote and/or reference the institution's material contained within the "Guidelines for the Handling and Disposal of Cytotoxic Agents and Contaminated Items by Nurses on the Hospital Ward, March 1986", for your thesis study entitled "Oncology Nurses' Perceptions of Occupational Exposure to Antineoplastic Drugs".

Sincerely,

Ms. Beth Perry
Education Coordinator
CROSS CANCER INSTITUTE

BP/jb

Appendix G

Tables Corresponding to Figures 1-18

List of Tables Corresponding to Figures in Body of Text

	Table / Figure(s)		Page
1.	1-7.	Demographic Characteristics of the 124 Nurses	119
2.	8.	Frequency of Antineoplastic Drug Administration	120
3.	9.	Recency of Antineoplastic Drug Administration	121
4.	10.	Combined Recency of Administration Amongst Respondents for all Four Classifications of Antineoplastic Drugs	122
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7.	17.	Nurses' Perceived Severity	125
8.	18.	Nurses' Mean Self-reported Health Ratings by Grouped Age	126

Table 1.

Demographic Characteristics of the 124 Nurses

Characteristic	Mean	S.D.	Range
Age (yrs.)	35.3	9.3	21-59
Nursing Experience (yrs.)	11.1	8.3	1-30
Length of Time since Basic Nursing Graduation (yrs.)	12.7	9.8	1-37
Length of Employment in Oncology Nursing (yrs.)	6.9	5.7	1 mo. -23 yrs.

	n	%
Education		
RN Diploma	88	71
Baccalaureate Degree	36	29
	124	100
Schedule of Work		
Full-time (38.75 hrs./wk.)	75	61
Part-time (≥15.5 hrs. < 38.75 hrs./wk.)	30	24
Casual (<15.5 hrs./wk.)	19	15
	124	100

Table 2.

Frequency of Antineoplastic Drug Administration

DRUG	Daily		≥3 to<5 qwk.		≥1 to<3 qwk.		<1 qwk.		none / uncer-tain		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
ALKYLATING AGENTS	27	22	15	12	31	25	39	31	12	10	124	100
VINCA ALKALOIDS	23	19	15	12	32	25	44	36	10	8	124	100
ANTIME-TABOLITES	26	21	12	10	33	27	44	35	9	7	124	100
ANTITUMOR ANTIBIOTICS	23	19	18	15	34	27	40	32	9	7	124	100
Total	99		60		130		167		40		496	

Table 3.

Recency of Antineoplastic Drug Administration

DRUG	today to ≤ 1 mo. ago		>1 mo.< 1 yr ago		1 yr. ≤3 yrs. ago		> 3 yrs. ago		never		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
ALKYLATING AGENTS	71	57	20	16	12	10	17	14	4	3	124	100
VINCA ALKALOIDS	82	66	14	11	11	9	15	12	2	2	124	100
ANTIME-TABOLITES	84	68	14	10	11	8	13	13	2	1	124	100
ANTITUMOR ANTIBIOTICS	84	68	13	10	10	8	16	13	1	1	124	100
Total	321		61		44		61		9		496	

Table 4.

Combined Recency of Administration Amongst Respondents for all Four Classifications of Antineoplastic Drugs

Recency	Observed Frequencies	Expected Frequencies
today to ≤ 1 mo. ago	321	124
1 mo. < 1 yr. ago	61	124
1 yr. ≤3 yrs. ago	44	124
> 3 yrs. ago	61	124
never	9	124
Chi square = 535.26	N=496	496

Table 5.

Occupational Exposures (Current and Throughout Nursing Career)

Occupational Exposures	Yes		No		Not Sure		Total	
	n	%	n	%	n	%	n	%
Current Antineoplastic Drug Exposure	100	80	24	20	0	0	124	100
Ionizing Radiation	109	88	12	10	3	2	124	100
Anesthetic Gases	93	75	30	24	1	1	124	100
Chemical Solvents / Sterilizing Agents	117	94	5	4	2	2	124	100

Table 6.

Nurses' Perceived Susceptiblity

	High level of Perceived Susceptibility Ratings = 4-7				Low Level of Perceived Susceptibility Ratings = 1-3				Overall Mean Perception of Susceptibility			
Conditions	Mean	S.D.	n	%	Mean	S.D.	n	%	Mean	S.D.	n	%
Increased Susceptibility to Illness	4.64	0.76	25	20	1.9	0.79	99	80	2.45	1.35	124	100
Skin Rash	5.65	1.13	26	21	1.6	0.74	98	79	2.45	1.85	124	100
Dizziness	5.00	1.41	2	2	1.3	0.54	122	98	1.36	0.73	124	100
Irritability	5.10	1.20	10	8	1.29	0.51	114	92	1.6	1.20	124	100
Eye Infection	5.13	1.13	8	6	1.42	0.64	116	94	1.66	1.13	124	100
Miscarriage	5.00	1.05	21	17	1.54	0.75	103	83	2.13	1.53	124	100
Cancer	4.54	0.93	24	19	1.85	0.78	100	81	2.37	1.34	124	100

Table 7.

Nurses' Perceived Severity

Mean Severity Ratings= 1 (low) to 7 (high)

Conditions	Mean	S.D.	n	%
Increased Susceptibility to Illness	5.04	1.59	25	20
Skin Rash	3.77	1.75	26	21
Dizziness	4.50	0.71	2	2
Irritability	5.20	1.62	10	8
Eye Infection	5.88	1.73	8	6
Miscarriage	6.29	1.45	21	17
Cancer	6.79	0.66	24	19

Table 8.

Nurses' Mean Self-Reported Health Ratings by Grouped Age

	Nurses' Mean Health Ratings	Nurses' Ages Expressed in Years		
		n	%	Age(yrs.)
1= Poor Health				
Barely Able to Work				
	5.930	43	35	21- 29
	6.579	38	31	30- 39
	6.324	34	27	40- 49
7= Excellent Health	6.889	9	7	50- 59
No Trouble Working				
	Total	124	100	